



Knox County Fire and Rescue Evaluation



County Technical Assistance Service
INSTITUTE FOR PUBLIC SERVICE

Contents

Objectives	2
History	3
Demographics	9
Current Deployment Model	17
Coverage Areas	17
Stations	17
Distance	19
Driving Time Projections	22
Incidents	26
Incident Response Time	32
Staffing	33
Apparatus	34
ISO Ratings	36
Training Facilities	38
Fire Hydrants/ Water Supply	40
Fire Prevention	42
Operations	43
Services Provided	43
Rural Metro Fire Department	43
Karns Fire Department	43
Seymour Vol. Fire Department	44
Knoxville Vol. Rescue Squad	44
NFPA Standards	45
NIST Study	46
Funding	47
Current Model	47
Funding Maps	49
Public Funds	52
Grant Opportunities	52
Recommendations	53
Summary	57

Objectives

The Knox County Commission requested by Resolution *R-16-2-903* for the University of Tennessee's County Technical Assistance Service to conduct an evaluation of "the fire and emergency services currently provided in Knox County and the County's potential future needs and report back to the Commission."

This request was further defined as an evaluation of:

- Current station locations, coverages and response areas
- Status of equipment/ apparatus
- Staffing levels
- Interdepartmental working relationships
- Funding

This process was completed through analysis of incident data, geographic information system (GIS) modeling, station visits, and interviews with personnel both inside the agencies and other associated entities and officials. All data utilized in this study was self-reported by the agencies. For the purpose of this study, the Town of Farragut is included in the analysis.

The evaluation is not intended to be a management review of the existing fire and rescue organizations.

History

While the corporate boundaries of the City of Knoxville remained unchanged for a period of about fifty years starting around World War I, population and development did not. At least three fire departments formed to protect the suburban and rural population growing just outside the city's corporate limits: the Bearden, Fountain City and Norwood Fire Departments. These departments were funded by contracts with property owners (subscriptions.) A change in the state's annexation laws led to all three communities being annexed into Knoxville in 1962. Two of the three departments attempted to continue service to neighborhoods outside the city's expanded limits but failed, being unable to generate enough subscribers.

Population growth outside the city continued, and new organizations formed to provide fire protection. The first was the West Knoxville Fire Department (WKFD) formed to protect Lovell Hills in 1964 followed by the Seymour Volunteer Fire Department (SVFD) in 1971. By the time the East Tennessee Development District (ETDD) surveyed fire protection in the sixteen-county district in 1974, additional departments had formed in Powell, Halls and East Knox County. The ETDD study was critical of these departments, citing their weakness, potential instability, and the absence of regulation. What the study did not address, although it appears in the data it collected, was that these departments were subsisting on revenues of less than a quarter of the average for the district.

The ETDD study was correct on one point: the suburban fire departments were unstable. The West Knoxville Fire Department entered a one-year management contract with Rural/Metro Fire Department (RMFD) of Arizona, an organization that had successfully expanded to serve rapidly-growing suburban communities in that state. Within a year, WKFD assumed responsibility for the East Knox County Fire Department, which had failed. Rural/Metro made recommendations as a result of its involvement, including:

- Service needed to be provided whether residents were subscribers or not
- WKFD needed to diversify by adding rescue and emergency medical response
- WKFD needed to upgrade its fleet and supplement its on-duty staffing with on-call firefighters alerted by radio

And, most importantly, the department needed to operate county-wide in order to have enough scale to assure long-term stability. WKFD did not have the capital resources to implement the recommendations, let alone to acquire the remaining three departments in the county. Rural/Metro did have the resources though, and the two agencies formed a partnership to provide service county-wide on June 21, 1977. Rural/Metro assumed full responsibility in 1984 after buying West Knoxville's remaining interest.

At very nearly the same time, Knox County formed its own fire department to serve two industrial parks, one in Byington-Solway and the other at the Forks of the River. However, the county did not establish a sustainable funding source for its department. The department was provided government surplus equipment, and some donated pick-up trucks from the Tennessee Valley Authority. The firefighters were paid with Federal Comprehensive Employment and Training Act (CETA) funds, and, as CETA was designed as a training program, the firefighters had to be released after one year and replaced with new trainees.

The county government changed in 1980 from a County Court to a legislative commission and county executive. The first county executive, Dwight Kessel, dissolved the department in 1981 when the CETA program ended. Several residents who had sought to serve as volunteers for the Byington Solway station separated to form the Karns Volunteer Fire Department (KVFD) in 1978. A fourth department, Heiskell Volunteer Fire Department (HVFD), organized in 1981, and a fifth, the Carter Volunteer Fire Department, formed a few years later but dissolved after a few months for lack of financial support.

The county and its four fire departments (RMFD, KVFD, SVFD, HVFD) co-existed for a time with little interaction. That changed in the fall of 1983 when two apartment fires occurring about eight weeks apart and both located in west Knox County destroyed twenty-four units in one fire and almost as many in the other and resulted in one death. The fires resulted in the recognition of fire protection as a public issue, and the creation of the Knox County Fire Prevention Bureau in 1984. The county then adopted codes more stringent than those minimally required by the state.

Another result was the initiative to acquire 911 emergency phone service to the county, which required the county to define the service area boundaries for the fire departments. The county deepened its relationship with RMFD by contracting with it for an additional person (later two) to assist its Prevention Bureau with fire investigations and public fire safety education.



Westbridge Apartment Fire, August 1, 1983. Twenty-four units were destroyed.

Effect of Home Rule

In 1990 Knox County's form of government changed again, this time to a charter form of government that had been approved by the voters the year before. This change gave the county certain expanded powers such as the ability to pass ordinances and create special districts. The previous year the county entered into an agreement with RMFD to provide a hazardous materials team but had otherwise not asked for specialized emergency services, perhaps in part because of its limited legal powers. A major fire occurred in the Forks of the River Industrial Park in 1992, during the height of a series of contentious legal battles between the county and the City of Knoxville. The city responded to the fire as well as RMFD, citing an unwritten 1969 agreement, and it then demanded payment for the response. In reaction, the county

disavowed the unwritten agreement with the city. It also used its new charter powers to create a special tax district encompassing the park and several residential and commercial properties in the vicinity for the purpose of contracting with RMFD to provide service there. The county designated a parcel within the park for the new fire station, deeding it to a private developer for the actual construction.

The creation of the fire district at the Forks of the River was only the latest example of a pattern of county actions over a quarter of a century. An event would occur, for instance a major fire, and the county would deepen its relationship with Rural/Metro without replacing the agency with one it owned outright. In 1993 the Knox County Commission authorized a formal study of its emergency services. The study was conducted by a division of the insurer Hartford Steam Boiler (HSB), which presented the results to the Commission in the summer of that year. Its evaluation included a mix of criticism and praise, noting, among other things, that the county owned none of the equipment or facilities. To address these shortcomings, the report recommended expanding the fire district to incorporate all the county outside the City of Knoxville, including the Town of Farragut. The recommendation rejected contracting with the city for service, establishing a county-owned fire department, or contracting directly with Rural/Metro; but instead called for the creation of an independent public corporation that would receive the funds and subcontract with RMFD and the existing volunteer departments. This arrangement would allow the county to expand or replace the departments as it deemed necessary. The Commission tabled the recommendation.

The county not increasing its involvement, despite recommended actions, helps to understand better its subsequent responses. Firstly, there had been no major event such as the apartment fires in 1983 or the industrial fire in 1992, so the recommendation appeared to be a solution in search of a problem. Secondly, to make the recommendation appear cost effective, it included closing three of the existing fire stations, an idea that is never popular either with elected officials or the public. Thirdly, the study made several doubtful and unsupported assertions, for instance stating that the county could purchase fire apparatus for less than the amount manufacturers were quoting, or that facility costs could be offset by renting space in fire stations to banks to place automatic teller machines. Fourthly, the recommendation seemed to suggest that the independent public corporation could choose to subcontract with any company or agency (not necessarily with RMFD) without direction or approval from Commission. Finally, the evaluators had no satisfactory plan for how service would be provided during a transitional period, should significant numbers of Rural/Metro subscribers elect to cancel their subscriptions in anticipation of publicly funded service. The study also failed to consider how a serious loss of income to Rural/Metro, for its fire services, might affect its ability to continue its contract to provide the county ambulance service.

There were also other lesser issues with how the study was conducted; for example, it cited comparative data from a voluntary survey that appeared in a trade magazine, instead of from an authoritative source such as the International City/County Management Association. The deviation from the ability of the county to use RMFD as its proxy, and to make change through incremental advances in the partnership as the Commission required, is likely the primary reason why the recommendation was not adopted.

Effect of County Study on Farragut

The HSB study had one other effect. From its incorporation in 1980 until the HSB study, the Town of Farragut had been content to allow RMFD to serve it without a formal arrangement. Several of the fire stations that the HSB study recommended closing were in Farragut or adjacent West Knox County. To preclude a future initiative from affecting fire service to the Town, it entered into a separate, formal

contract with RMFD in 1993. Simultaneously, the Town entered into a second contract with RMFD to provide inspection and other fire prevention services. The contract has been continually renewed with incremental changes since that time.

Rural/Metro

Rural/Metro, now part of American Medical Response, Inc. (AMR), was founded in 1948 as a private fire department that provides fire protection and emergency medical services to individual homeowners and commercial businesses in unincorporated locations throughout the United States, primarily under a subscription-based model. In certain communities, RMFD partners directly with cities, towns, and fire districts under master fire contracts to provide a full complement of fire protection, prevention and emergency medical services.

RMFD, an ISO rated 3/3x department, has provided fire and emergency medical services to properties located within unincorporated areas of Knox County and the town of Farragut since 1977. Rural Metro Fire provides fire protection services primarily under a subscription-based model to individual homeowners and commercial property owners in unincorporated areas. These areas are not included within municipal fire department boundaries; therefore, property taxes do not include fire protection.

The RMFD operates 17 fire stations in Knox County and provides first responder services to an estimated 223,000 county residents within its response area, making it the third largest response jurisdiction in the state. All stations provide emergency medical response, and fourteen of its engine companies include paramedics. RMFD operates a hazardous materials team from the main fire station in the Town of Farragut.

In addition to emergency response, RMFD provides prevention services to the Town of Farragut, and Public Fire Safety Education to Knox County under separate contracts. It achieves cost-saving economies of scale by sharing emergency dispatching, fleet maintenance, and other support services with AMR Emergency Medical Services.

RMFD's parent company, AMR, provides emergency medical services to all areas of Knox County, including the City of Knoxville. AMR is required to respond to 90% of all emergency calls within a 10-minute response time. RMFD provides a significant service to AMR with its ability to deploy advanced life support engine companies in order to meet the response time provision in the contract. AMR's corporate headquarters are located in Denver, Colorado.

Karns Fire Department

The Karns Fire Department (KFD) serves an area of 65 square miles in four communities in Northwest Knox County. Karns, an ISO Class 4 department (for the entire area), has four fire stations strategically located in the Karns, Ball Camp, Hardin Valley and Solway communities. The headquarters facility, where the department's business affairs are managed, is located off Oak Ridge Highway in the Karns community. The department provides fire protection, Advanced Life Support (ALS), hazardous materials response, vehicle extrication, an assortment of technical rescue services, and public education for over 40,000 residents and businesses.

The Karns Fire department was formed in 1978 as a volunteer department and was known as the Karns Volunteer Fire Department (KVFD). It functioned as a volunteer department for 23 years and provided fire

and EMS first response. The department subsisted on voluntary donations from community residents and businesses.

In 2001 it was recognized that the KFD could not keep up with the emergency fire and EMS responses with its volunteer staff, and subsequently two full-time staff members were hired. At this time, the KVFD effectively became a Combination Fire Department. The two staff members worked primarily during the week, during normal business hours. Volunteer staff were key to responding on weekend and non-business hours. The department continued to survive on voluntary donations from community residents and businesses.

In 2010 the department recognized the increasing population, and the associated risks, in the response area and transitioned to a subscription-based funding model. This has allowed the department to keep up with the rapidly growing demand for services and the ever-increasing costs of service delivery. Today the department has evolved to comprise a staff of 19 fulltime firefighters. These firefighters are supplemented by a reserve staff, operating in an on-call capacity. The department responds from two primary stations, with two reserve stations, in a fleet of engine/pumpers, one aerial platform, two tanker trucks, three quick-response vehicles, and a complement of reserve engines.

Due to its current subscription-based funding model, the KFD is managed by a Board of Directors (BOD), consisting of members of the community

Seymour Volunteer Fire Department

The Seymour Volunteer Fire Department (SVFD), an ISO rated class 5/5x agency, serves over 20,000 homes (32,000 people), 400 businesses, 70 churches, 2 private schools, 8 public schools and Johnson University (with 400+ on-campus residents). The response area is spread across Blount, Knox, and Sevier counties with a total response area of approximately 118.6 square miles.

SVFD was started in 1971 by several area business owners. Up until this time, there was no fire protection between Knoxville and Sevierville. In the first year, twelve firefighters responded to 24 calls for service and their sole engine was stored outside in a vacant lot at the corner of Chapman Highway and Old Sevierville Pike.

By 1981 the department had grown to thirty-five members and had purchased a 4-wheel drive mini-pumper and three water tenders. Station One (headquarters) was completed as the department call volume grew to 250 calls per year. In 1991, the department added two additional stations and purchased three additional engines with a yearly call volume topping 800 calls for service. Aided by a grant from the University of Tennessee Medical Center, SVFD trained 15 first responders in 1990 and became one of the first volunteer fire departments in Tennessee to become a state-licensed first responder agency in 1995.

SVFD operates six stations with 17 vehicles and approximately 70 firefighters. SVFD remains an all-volunteer department, with the exception of the paid fire chief position, and provides vehicle rescue and emergency medical responder services.

In 2017, SVFD responded to 2,406 calls for service with the following breakdown:

- Knox Co. 857
- Sevier Co. 1,315
- Blount Co. 234

Budgets for the SVFD have increased by 30% with income decreasing by 12%. The estimated 2018-2019 operational budget for the Knox County portion of the response area is \$228,841.

Rescue Squad

In October of 1956, due to a community tragedy, a call was made in the community asking citizens to step forward and provide a Rescue Squad in Knox County. Immediately ten men stepped forward and met in a garage on Rutledge Pike. During this meeting, a vision evolved. These men attended a Red Cross first aid course and through a generous \$250 donation from the Jaycees of Knoxville, the Volunteer Emergency Rescue Squad of Knoxville bought its first half-ton panel truck.

Over the years, the vision continued to grow thanks to hundreds of dedicated, professional volunteers and committed community leaders. Just as there was a need in the 1950's, the need continues as thousands of accidents occur throughout the community every year. KQRS recently entered into an agreement with RMFD to ensure the staffing of three vehicle extrication trucks.

Today, in addition to vehicle extrication response, the agency provides technical rescue services in the unincorporated areas of Knox County and mutual aid in the region upon request.

Demographics

Knox County, Tennessee is approximately 526 miles in area, of which 80.5 %, or 423.8 square miles is outside the Knoxville incorporated city boundaries. The population of the county in 2017 was 461,860 as estimated by US Census American Community Survey April 1, 2010 to July 1, 2017 data.

The 2017 estimate represents an increase of 6.4% from the 2010 census, with the majority occurring outside the corporate limits of Knoxville.

	1980	1990	2000	2010	2017	2010-2017 Increase
Knox County Total	319,694	336,591	382,889	432,226	461,860	6.4%
Knoxville City	175,045	172,962	173,848	178,874	187,377	4.5%
Outside Knoxville	144,649	163,629	209,041	253,352	274,483	7.7%

The Town of Farragut's population in 1980 was 6,279 and is estimated at 22,729 in 2017.

The University of Tennessee's Center for Business and Economic Research estimates that Knox County will grow in population by 38%, or 165,000 residents, through 2040, higher than the 33% estimated for Tennessee as a whole, and 23% for the nation.

Knox County fire districts providing coverage to areas outside the city of Knoxville are shown on Figure 1. The fire districts are defined as:

- Rural Metro Fire Dept.- First due response zone for each of the staffed fire stations
- Seymour Volunteer Fire Department- The two Knox County stations are combined into "one" district
- Karns Fire Department- The four stations are combined into two fire districts with a staffed station and volunteer station in each

To estimate population by fire district, 2010 Census Blocks were assigned to districts if their centroids fell within district boundaries. By this method, 251,897 of the total 2010 Knox population (58.3%) were covered by Knox fire districts. This is 99.4% of the population reported in the 2010 Census Data as outside the Knoxville Census boundary. Total population and population per square mile for each district are shown on Figure 1.

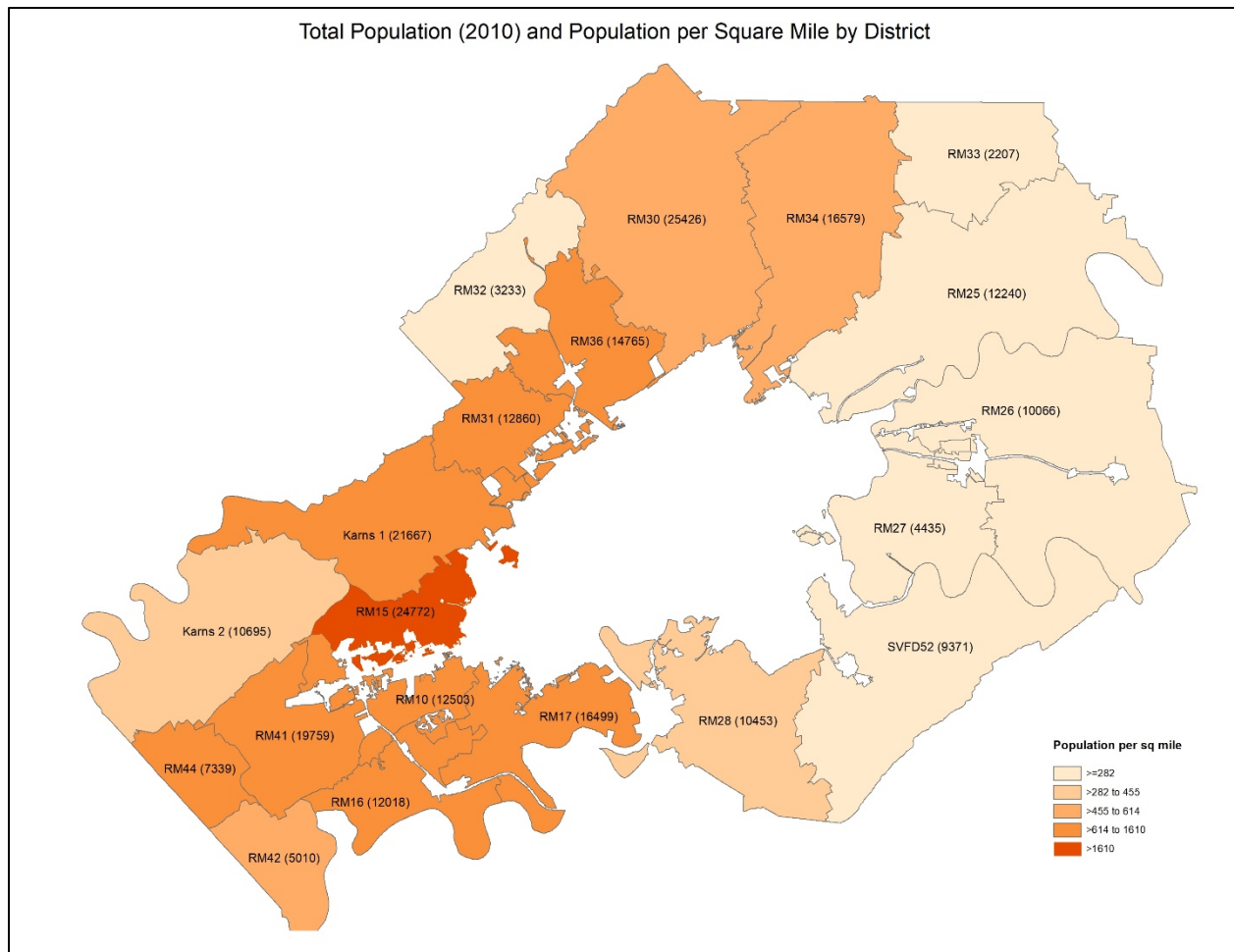


Figure 1 Total 2010 Population and Population per Square Mile by District

Fire district boundaries were provided by the Knoxville, Knox County, Knoxville Utilities Board Geographic Information System (KGIS) in September 2018. These were altered slightly to incorporate a verbal description of new boundaries for RM27. A final delineation of this boundary was not available when the study research was conducted.

KGIS also provided several other datasets for this analysis. Parcel data provided by KGIS in March 2017 included 194,415 parcels for Knox County. Parcel data did not include appraisal values for improvements. However, building footprint of all structures within the county were included and these were used as a proxy to estimate coverage of county property by Knox County Fire Districts. A plot of building densities shows the heaviest in the western part of the county and northwest of the incorporated area of the city (Figure 2).

Of the parcel datasets, 61.3 % (119,178) are served within Knox fire districts, representing 156,264 buildings, or about 64.5% of the 242,204 buildings on the KGIS building footprint dataset. The estimated current property value of all property of Knox County is approximately \$43.2 billion, of which 67% is outside of Knoxville city (2017 Tax Aggregate Report, TN State Board of Equalization).

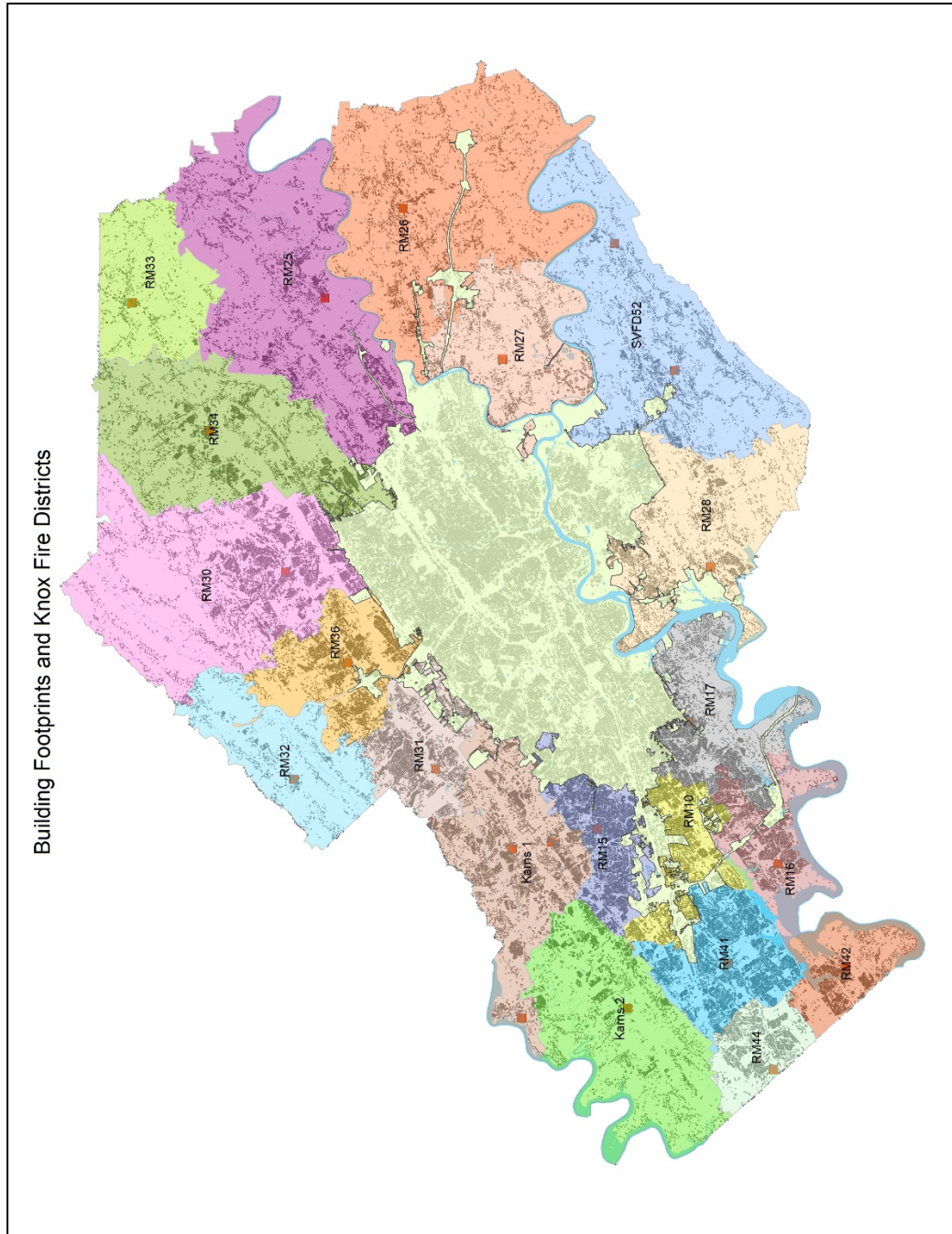


Figure 2 Building Footprints

Building density is also illustrated in Figure 3 by plotting the density of buildings footprint features using nine equal interval classes (*ArcMap 10.6 Spatial Analysis: 520' x 520' cell size, population = 1, kernel density Silverman bandwidth method*). This method is also used to visualize other density values in this report. The area of building footprints relative to total land area by district is shown in Figure 4.

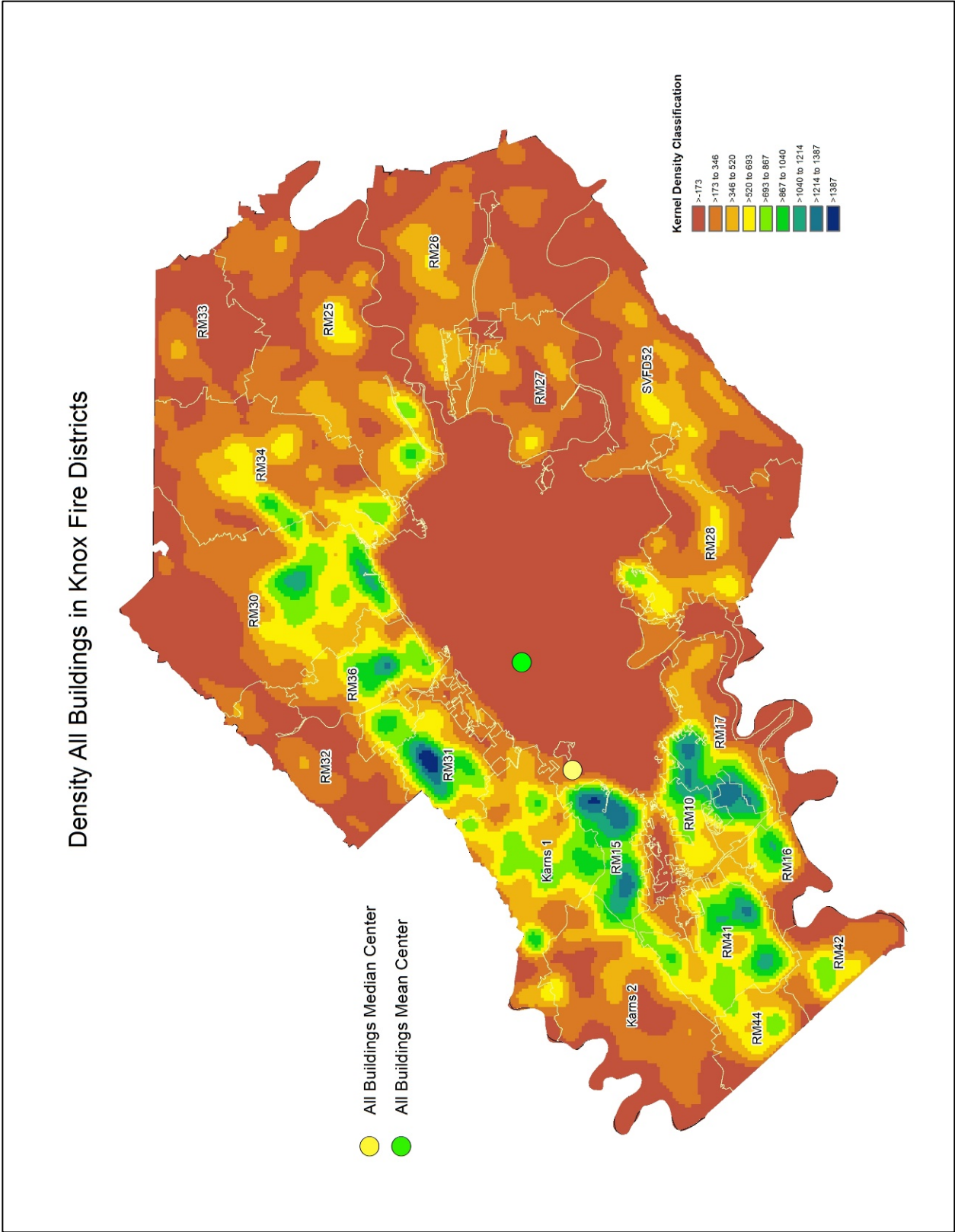


Figure 3 Building Density by Knox Fire Districts

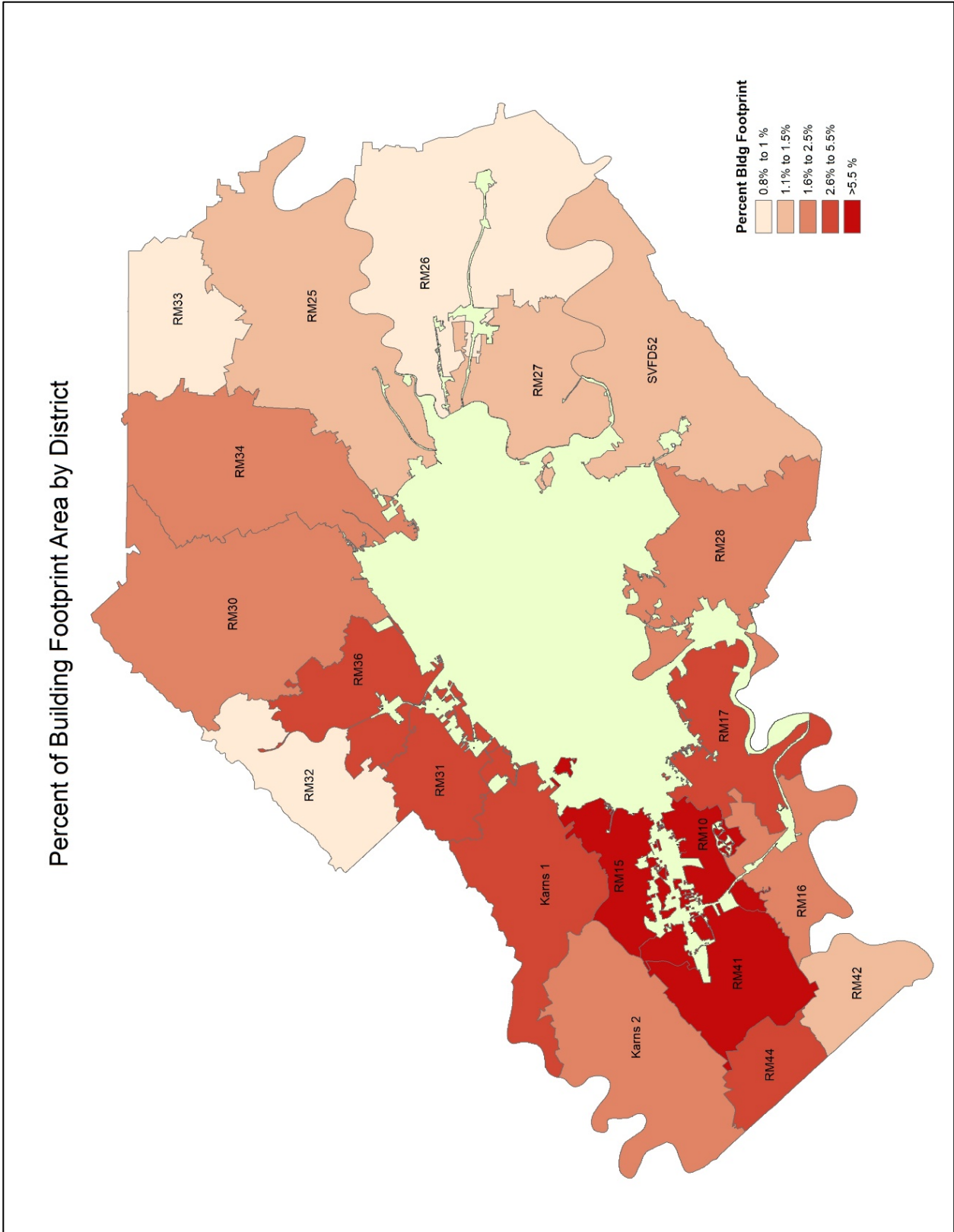


Figure 4 Percent of Building Footprint Area by Fire District

Figure 5 displays all parcels, outside the city of Knoxville, by tax class; Figure 5a charts these values. Figure 6 indicates the highest concentration of commercial and industrial buildings.

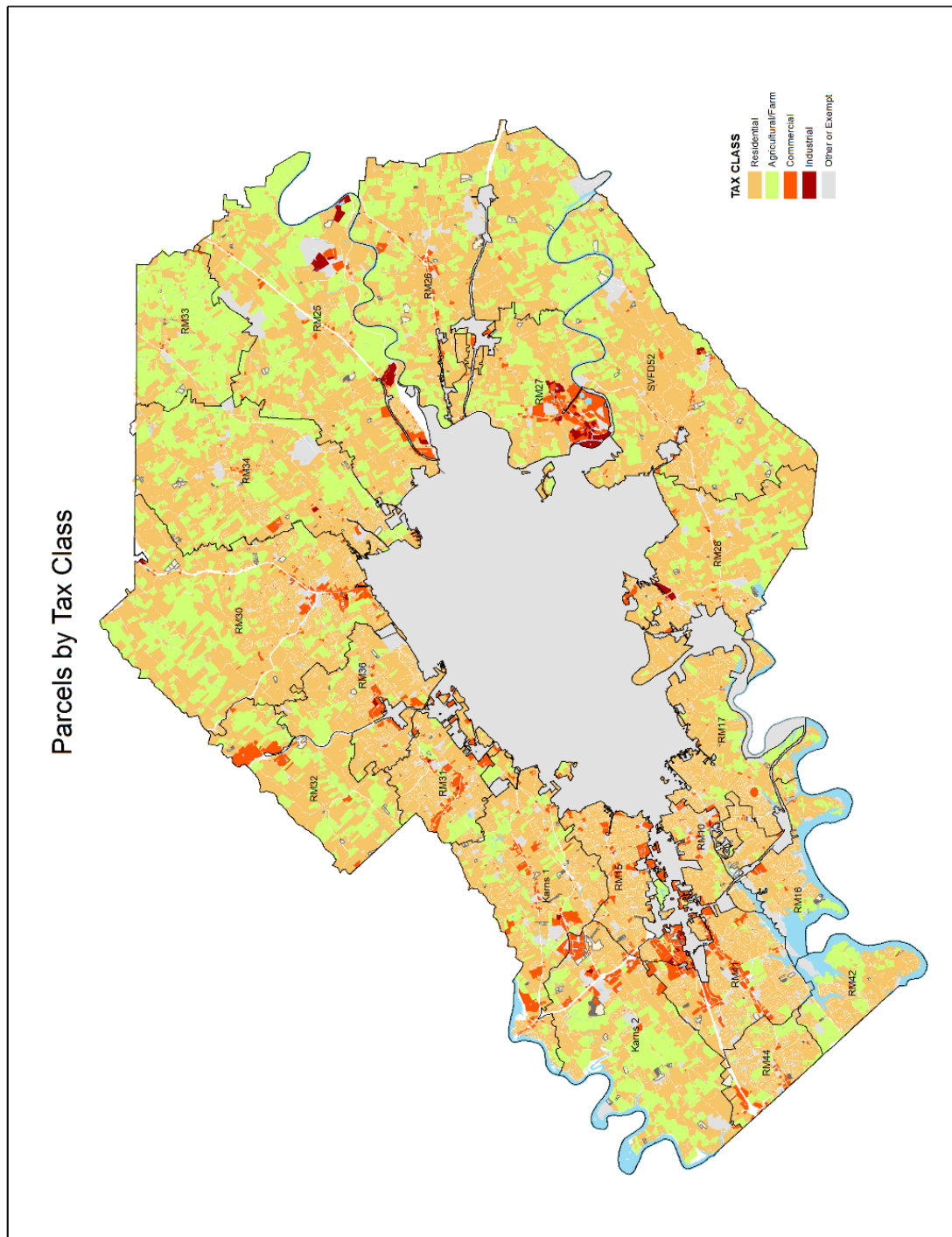


Figure 5 Parcels by Tax Class

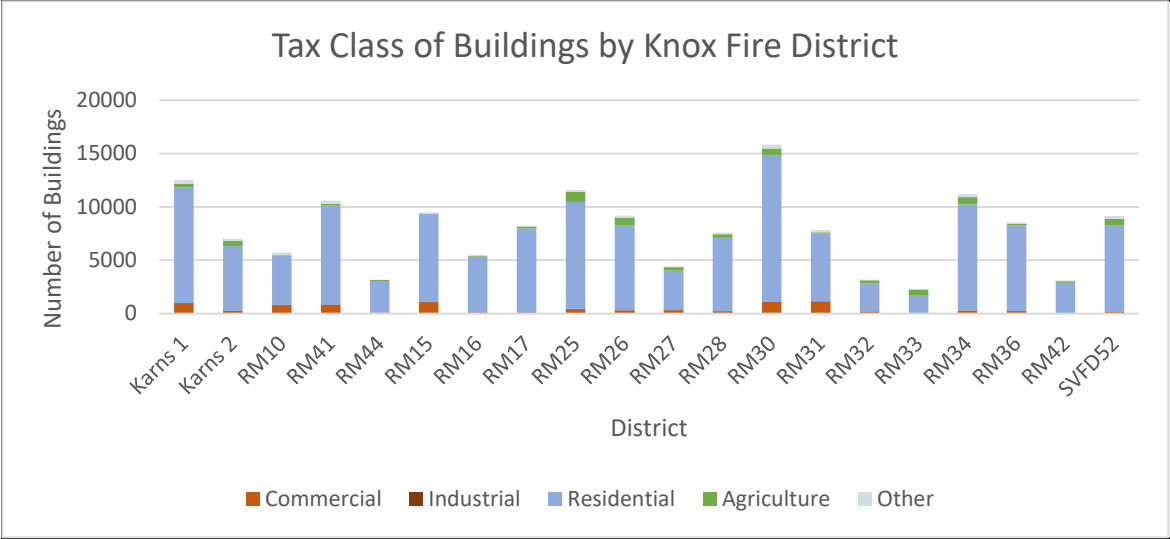
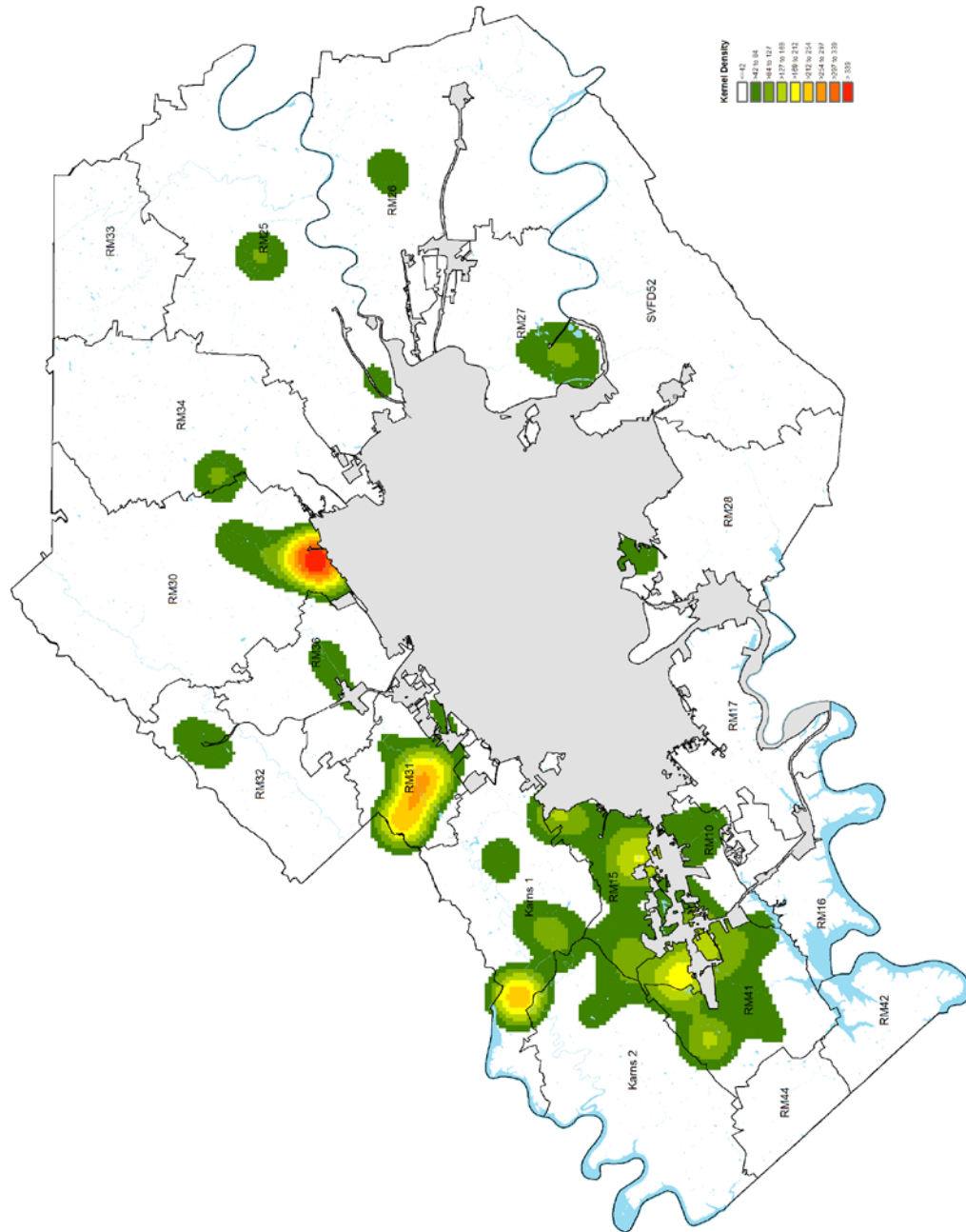


Figure 5a. Tax Class of Buildings by Fire District

Density of Commercial and Industrial Buildings



Current Deployment Model

Coverage Areas

Stations

The fire station locations are listed on the table below as submitted by the agencies. RMFD 27 is under construction and will move from its current location to a new facility on Strawberry Plains Pike. The KVERS station information were obtained from its website.

Department	Station #	Street Address	City	Zip
Rural Metro Fire	10	9746 Parkside Drive	Knoxville	37922
Rural Metro Fire	15	1012 Summerwood Drive	Knoxville	37923
Rural Metro Fire	16	10208 Bluegrass Road	Knoxville	37922
Rural Metro Fire	17	1332 Timbergrove Road	Knoxville	37919
Rural Metro Fire	25	8414 Old Rutledge Pike	Knoxville	37924
Rural Metro Fire	26	8707 Strawberry Plains Pike	Knoxville	37924
Rural Metro Fire	27	5525 South National Drive	Knoxville	37924
Rural Metro Fire	28	3111 Old Maryville Pike	Knoxville	37920
Rural Metro Fire	30	7401 Lena Lane	Knoxville	37918
Rural Metro Fire	31	7210 Old Clinton Pike	Knoxville	37921
Rural Metro Fire	32	9444 Heiskell Road	Heiskell	37754
Rural Metro Fire	33	9337 Davis Road	Corryton	37721
Rural Metro Fire	34	7309 Tazewell Pike	Corryton	37721
Rural Metro Fire	36	7615 Norman Jack Lane	Powell	37849
Rural Metro Fire	41	160 North Campbell Station	Farragut	37934
Rural Metro Fire	42	1712 Choto Markets Way	Knoxville	37922
Rural Metro Fire	44	201 Watt Road	Farragut	37934
Rural Metro Fire	67	1500 Duncan Road	Knoxville	37919
Karns Fire	1	6616 Beaver Ridge Rd.	Knoxville	37931
Karns Fire	2	2150 N. Campbell Station Rd.	Knoxville	37932
Karns Fire	3	4725 Guinn Rd.	Knoxville	37931
Karns Fire	4	8109 Ball Camp Pike	Knoxville	37931
Seymour VFD	2	7915 Chapman Highway	Knoxville	37920
Seymour VFD	6	2135 Kimberlin Heights Road	Knoxville	37920
KVERS	1	512 N. Chilhowee Drive	Knoxville	37924
KVERS	3	1100 E. Governor John Sevier Hwy	Knoxville	37920
KVERS	4	6820 Tice Lane	Knoxville	37918

Coverage areas for each station were estimated both by distance and driving time using ArcGIS 10.6 Network Analyst software. The KGIS street network was used to estimate driving distances across the coverage area. The ESRI Streetmap Premium Geocoding service was used to estimate driving times.

The location efficiency of fire stations was first assessed using the KGIS Street network and the ArcMap 1.6 Closest Facility Analysis. The closest facility, based on distance, for each of the 156,264 buildings in

the Knox County fire district coverage area was identified by routes plotted for each facility. This network is shown in Figure 7, overlaid on fire district boundaries. In most cases, fire district boundaries closely conform to this distance network model.

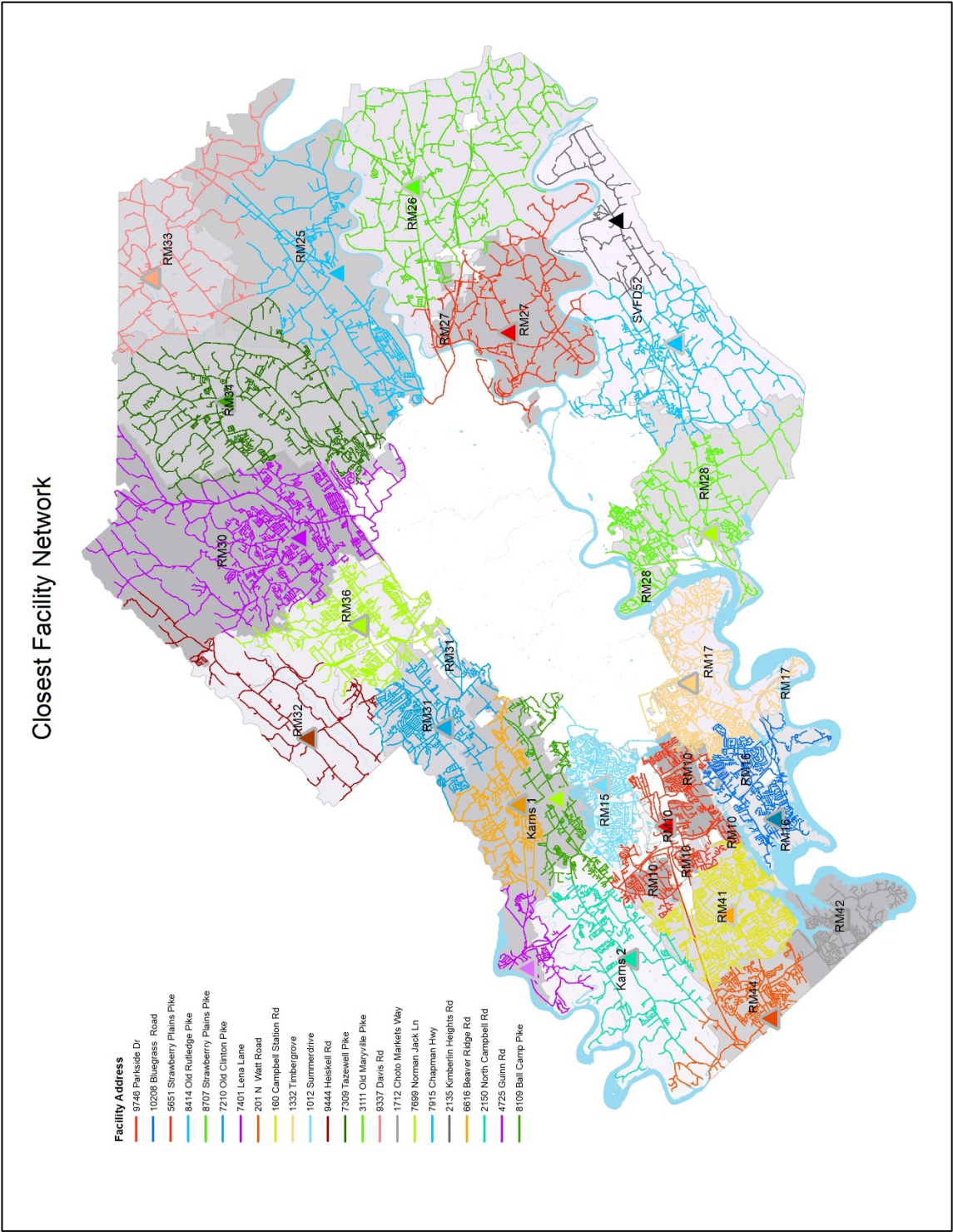


Figure 7 Closest Facility Network

Distance

Location efficiency by driving distance was assessed by estimating the number of buildings of the total 156,264 served by Knox County Fire District are within 1.5-mile, 2.5-mile, and 5-mile distance zone polygons created using ArcGIS Network Analyst software. Fire station service area polygons were created using the KGIS street network. The number of buildings and percentage of total buildings in the Knox County Fire District coverage area is shown in the table below followed by three maps showing the each of the zone boundaries.

	1.5 Mile	2.5 Mile	5 Mile
No. of Buildings	35,892	83,148	139,131
% of Total	22.97%	53.21%	89.04%

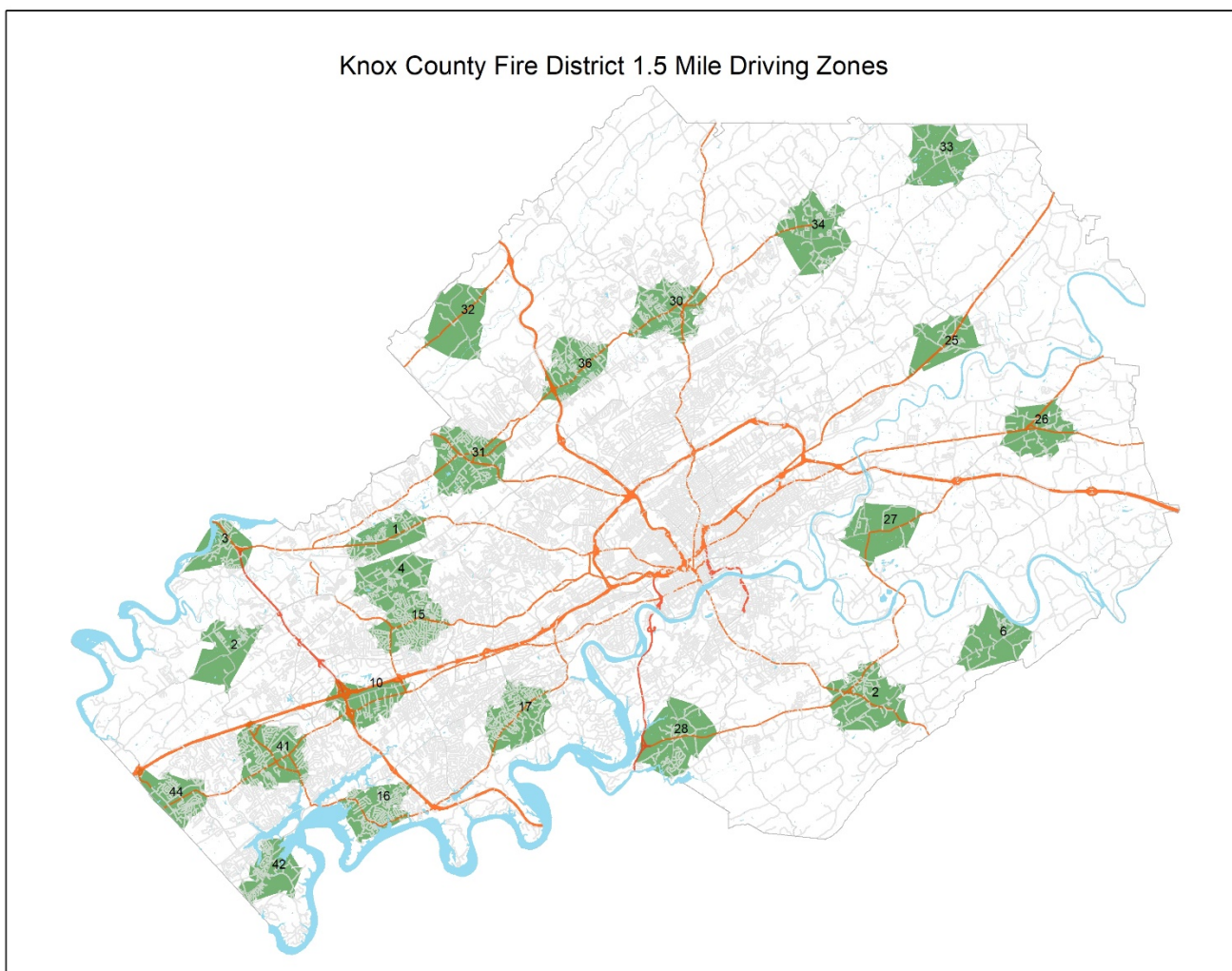


Figure 8 Knox Fire 1.5 Mile Driving Zones

Knox County Fire District 1.5 and 2.5 Mile Driving Zones

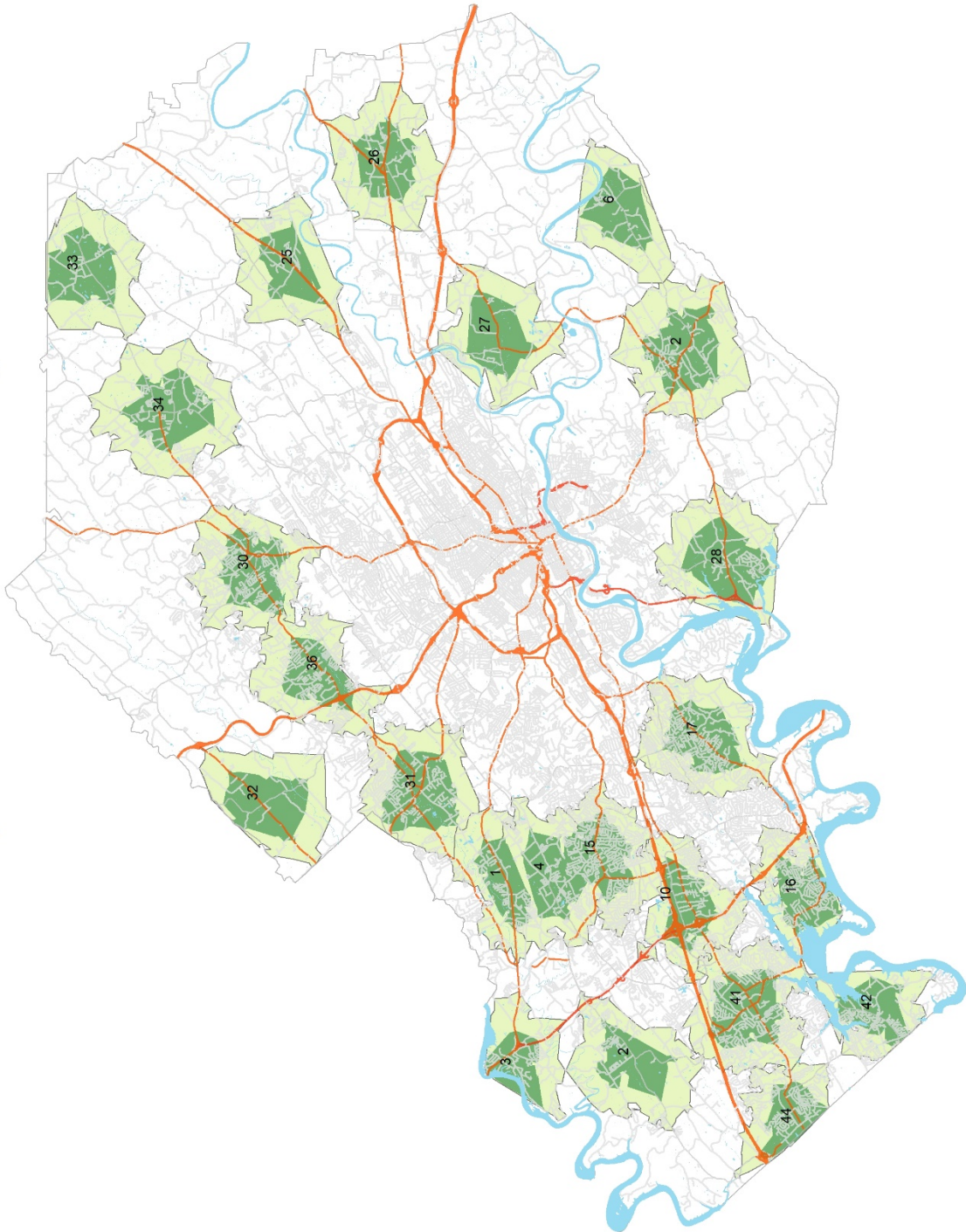


Figure 9 Knox Fire 1.5 and 2.5 Mile Driving Zones

Knox County Fire District 1.5, 2.5 and 5 Mile Driving Zones



Figure 10 Knox Fire 1.5, 2.5 and 5 Mile Driving Zones

Driving Time Projections

Driving times from each station were estimated using the ArcGIS Pro 4.0 Network Analyst using hierarchy preference for fastest routes. No traffic obstructions or time of day variances were modeled. Building coverage for 5, 7, and 10-minute driving times were estimated as shown in the table below, followed by zone maps for each time category:

	5 minutes	7 minutes	10 minutes
No of Buildings	80,409	130,885	152,304
% of Total	51.46%	83.76%	97.47%

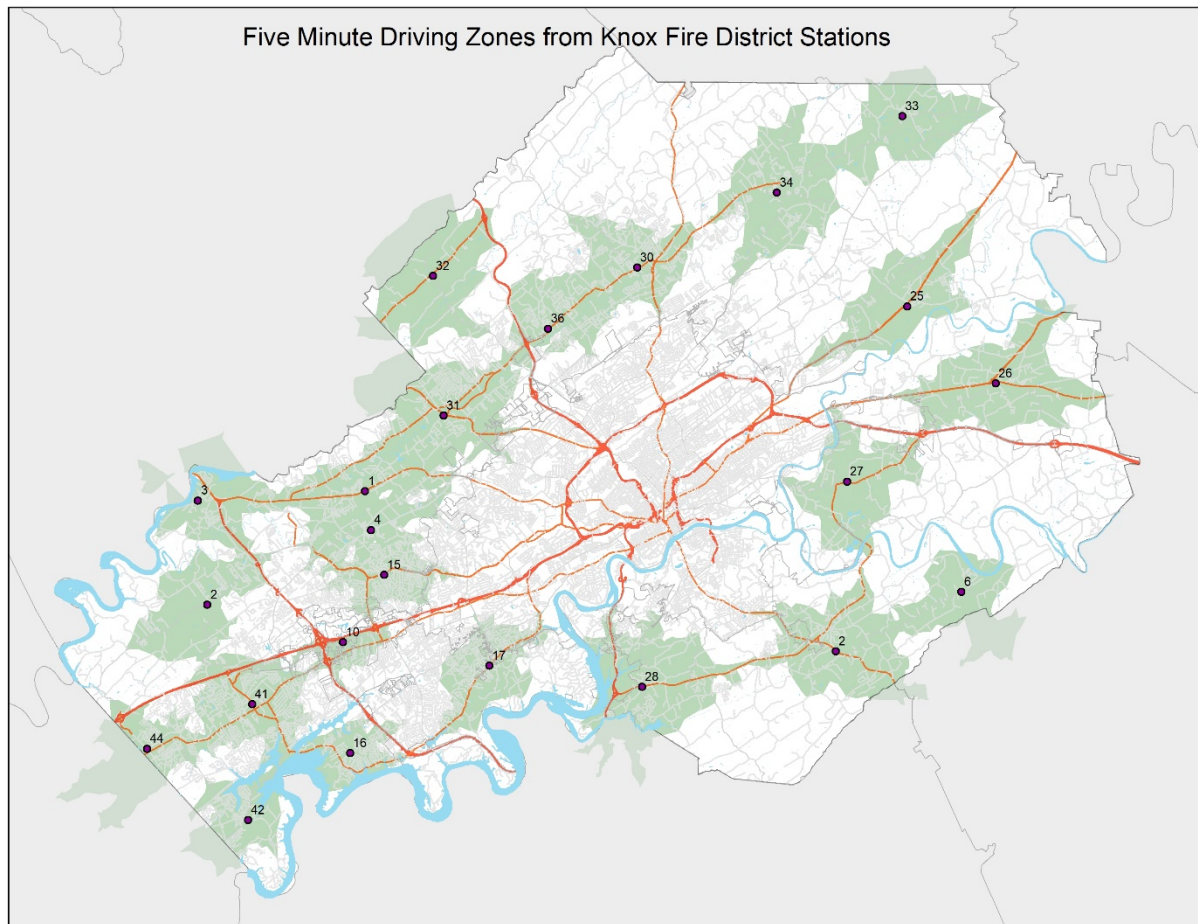


Figure 11 Five Minute Driving Zones

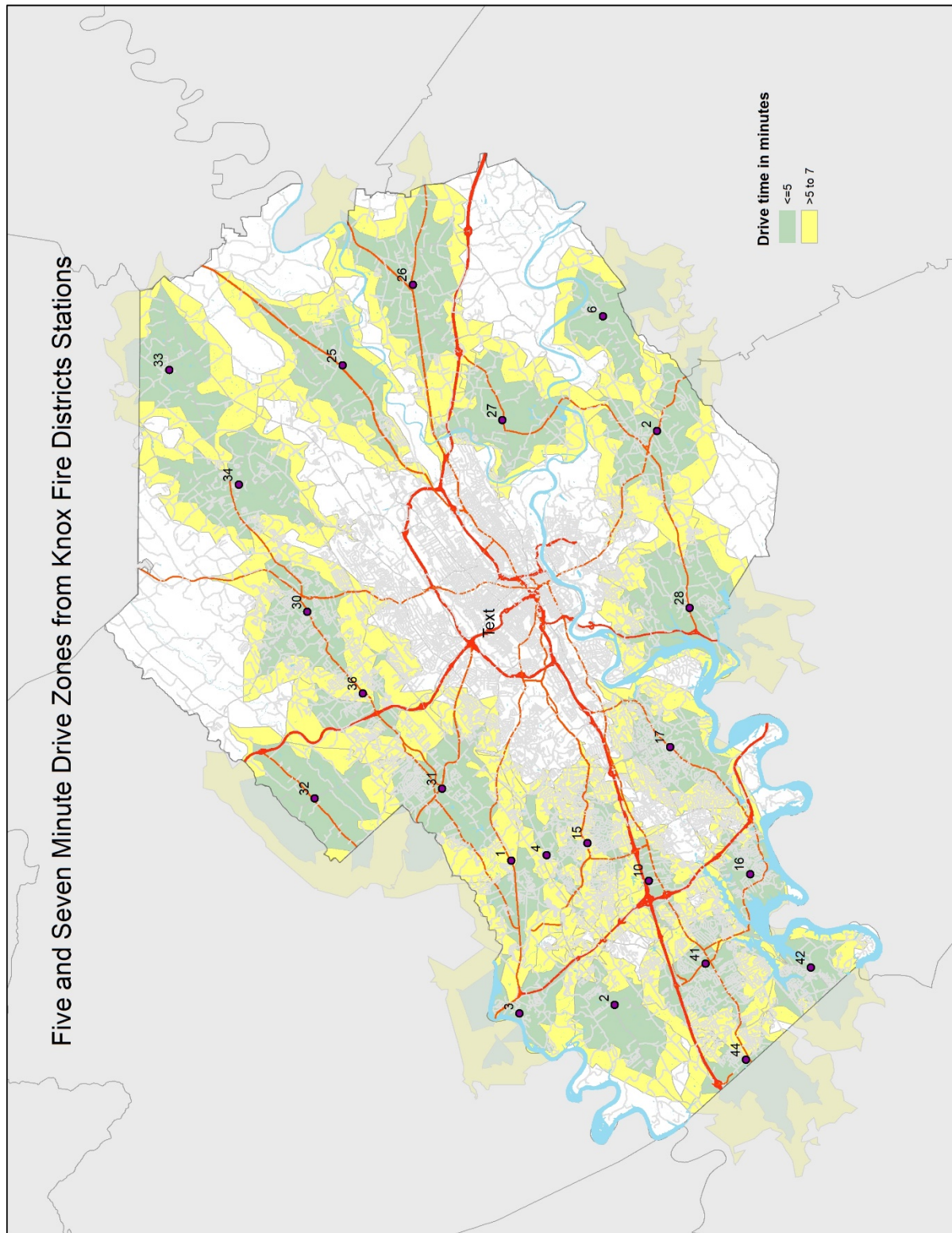


Figure 12 Five and Seven Minute Driving Zones

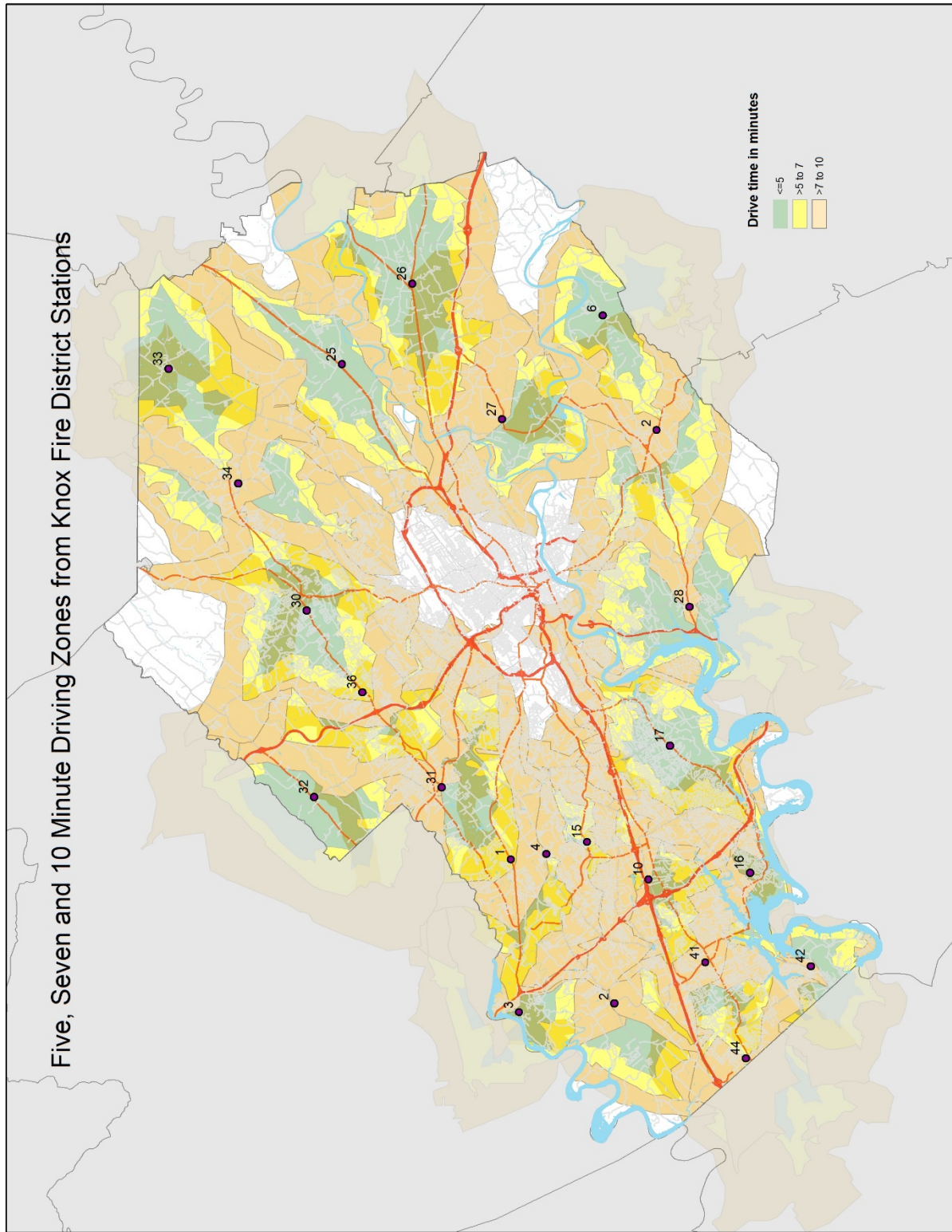


Figure 13 Five, Seven, and Ten Minute Driving Zones

The density of the 2.5% of buildings outside the 10-minute driving time zone from Knox County fire district stations is shown in Figure 14

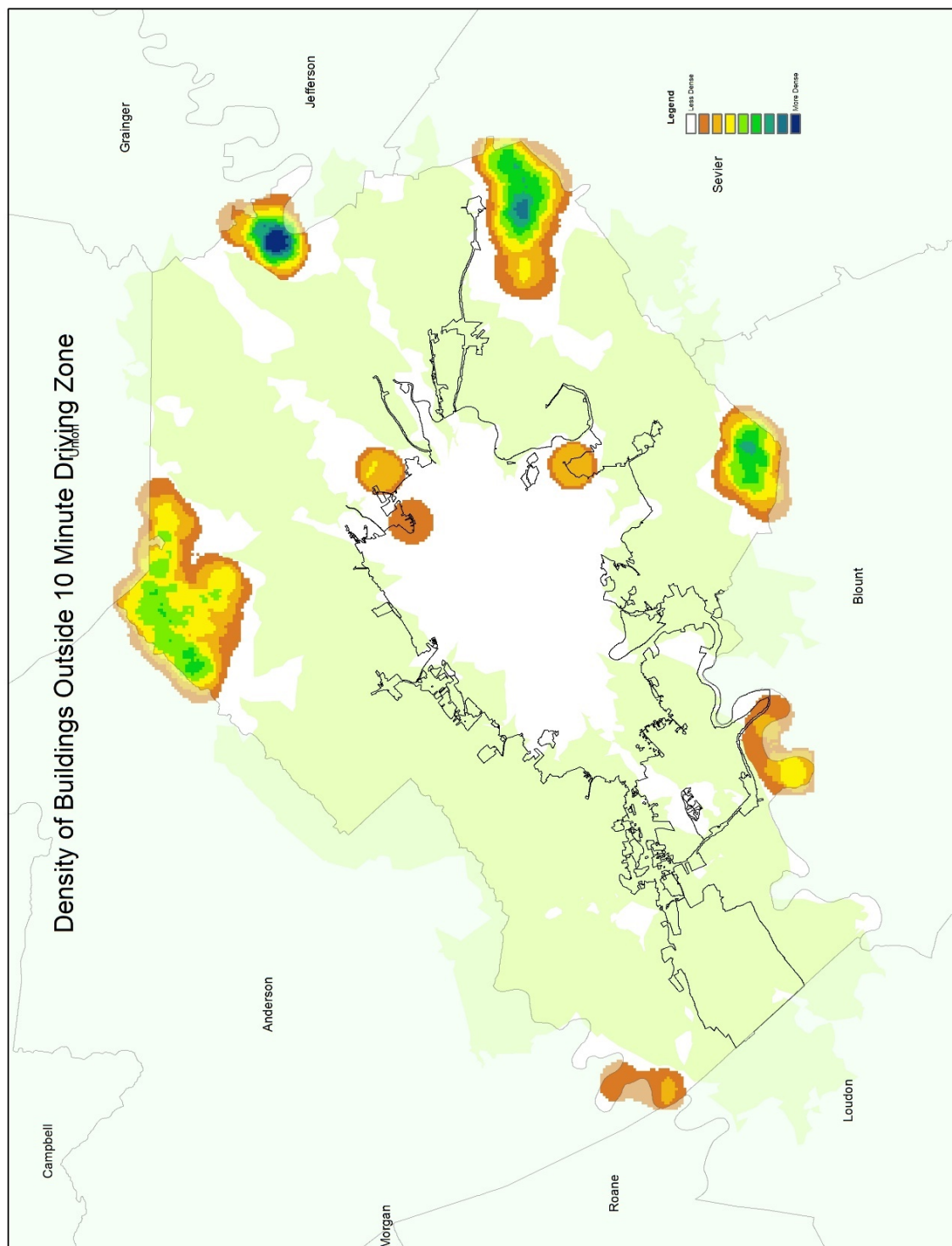


Figure 14 Building Density Outside 10 Minute Driving Zones

Incidents

Data for 21,376 incidents was provided for a one-year period beginning October 2016 - October 2017 by the KVERS and the RMFD, Karns and Seymour fire districts.

Source	Incident Count	Incident %
KFD	2,481	11.6%
KVERS	1,663	7.8%
RMFD	16,185	75.7%
SVFD	1,047	4.9%
Total	21,376	100%

Incident locations were geocoded by street address using several datasets, including the ESRI World Atlas geocoder, an address locator based on address data in the Knox parcel dataset, and Google Maps. Incidents that were identified as “Dispatched but cancelled” or as test records were not geocoded. Of the total remaining, 122 incidents could not be geocoded using these methods and 1,000 were in areas outside fire station boundaries, either within the incorporated area of Knoxville or outside Knox County boundaries. Point locations of all incident geocoded addresses are shown in the Figure 15, excluding 11 which were located outside the map extent shown.

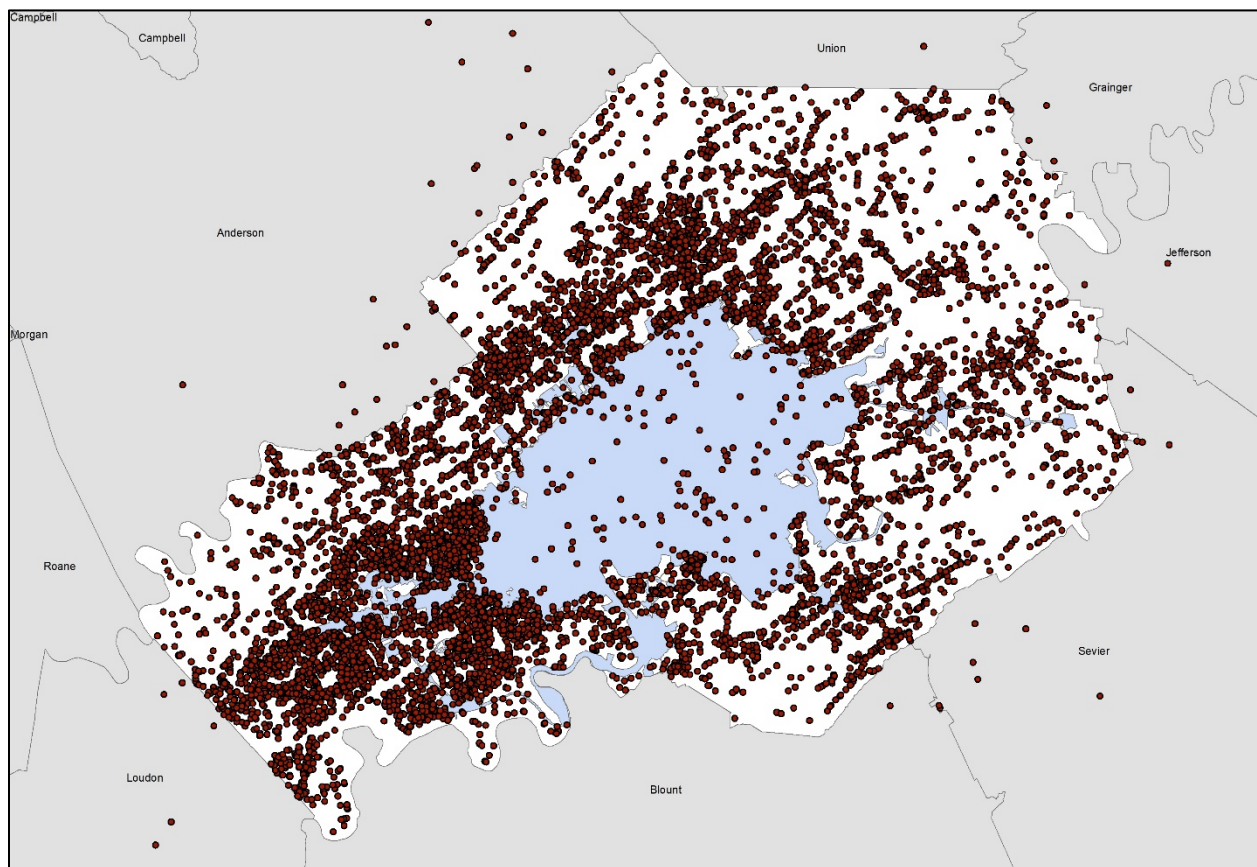


Figure 15 Knox County Incidents

Figure 16 depicts the incident location and density. This map includes point locations of geocoded incidents with a kernel density overlay (*ArcMap 10.6 Spatial Analysis: 520' x 520' cell size, population = 1, kernel density Silverman bandwidth method*). Figure 17 estimates a relative incident rate by district as the number of incidents divided by total number of buildings within each district

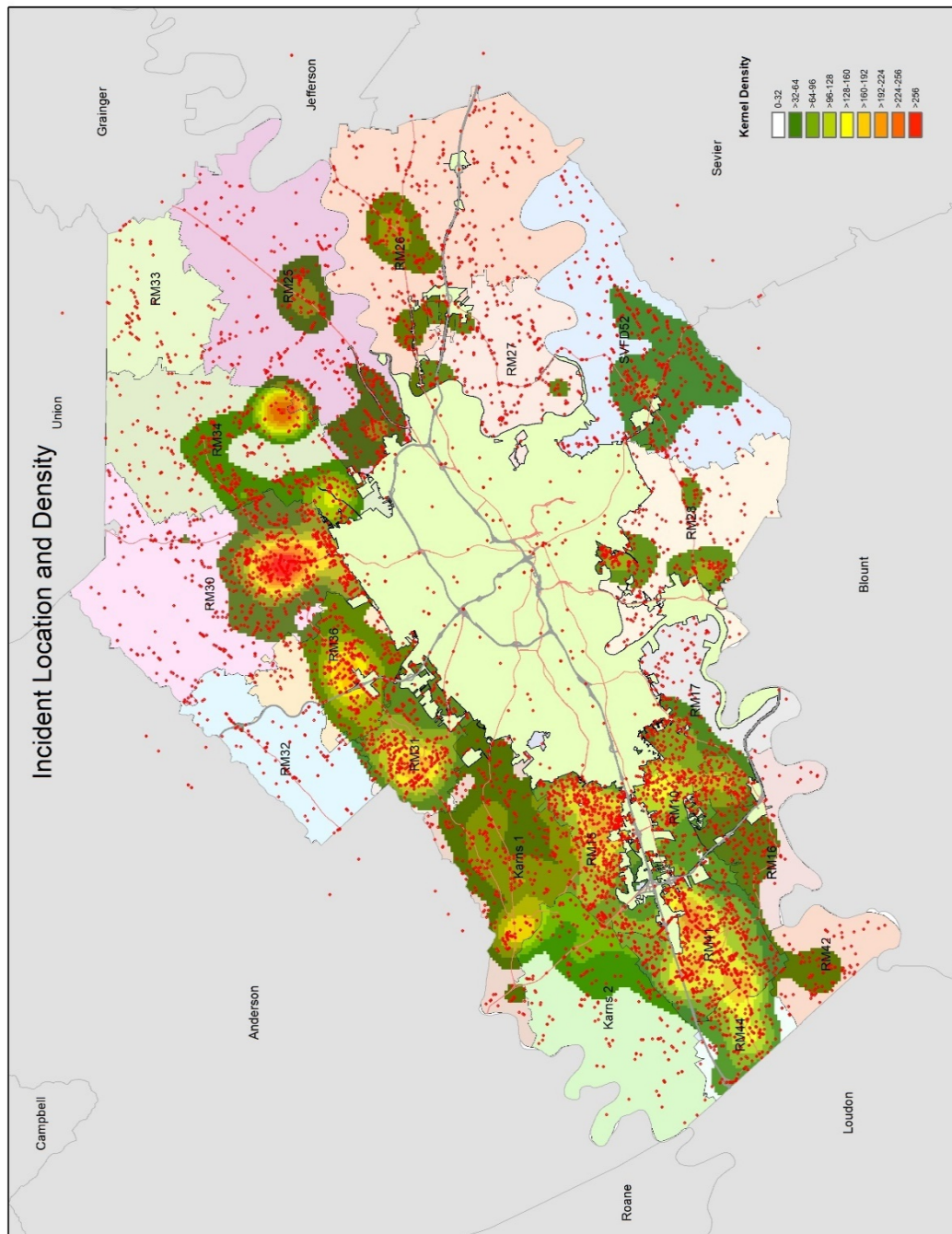


Figure 16 Incident Location and Density

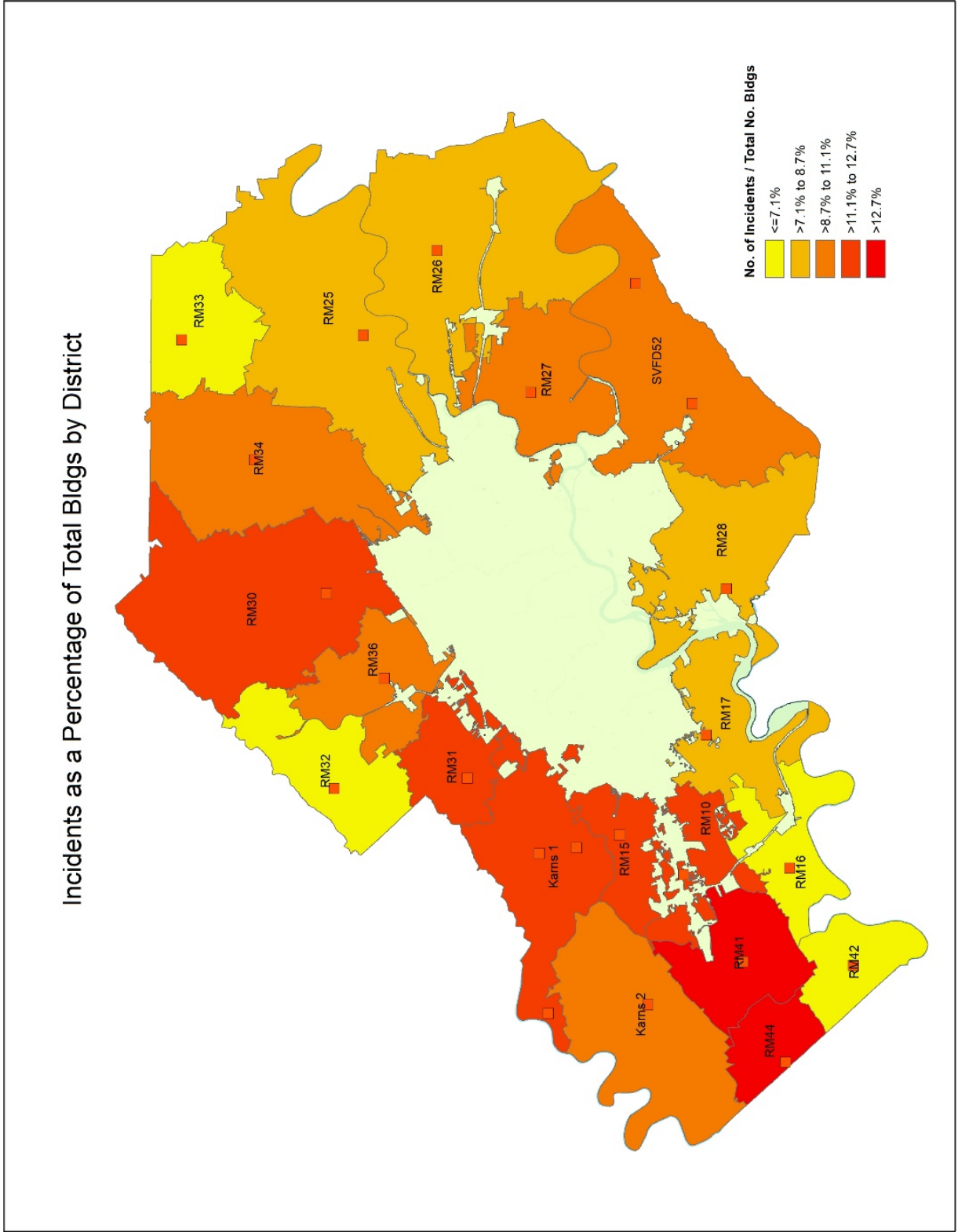


Figure 17 Incidents as a Percentage of Buildings by Fire Districts

Because incident description categories differed among providers, incidents were classified according to NFIRS general categories using the NFIRS code if it was present and manually assigning a category if the NFIRS code was not provided. The number of incidents and percentage of total incidents by category for each Knox County fire district is shown in the table below.

Of the 21,376 records, 3,579 were listed coded as “Dispatched and cancelled in route” or as test records. Most of these cancelled or test records, numbering 3,327, were coded as “Good Intent” calls, with the remaining as Rescue and EMS. Cancelled/test record incidents were distributed relatively uniformly across the service area.

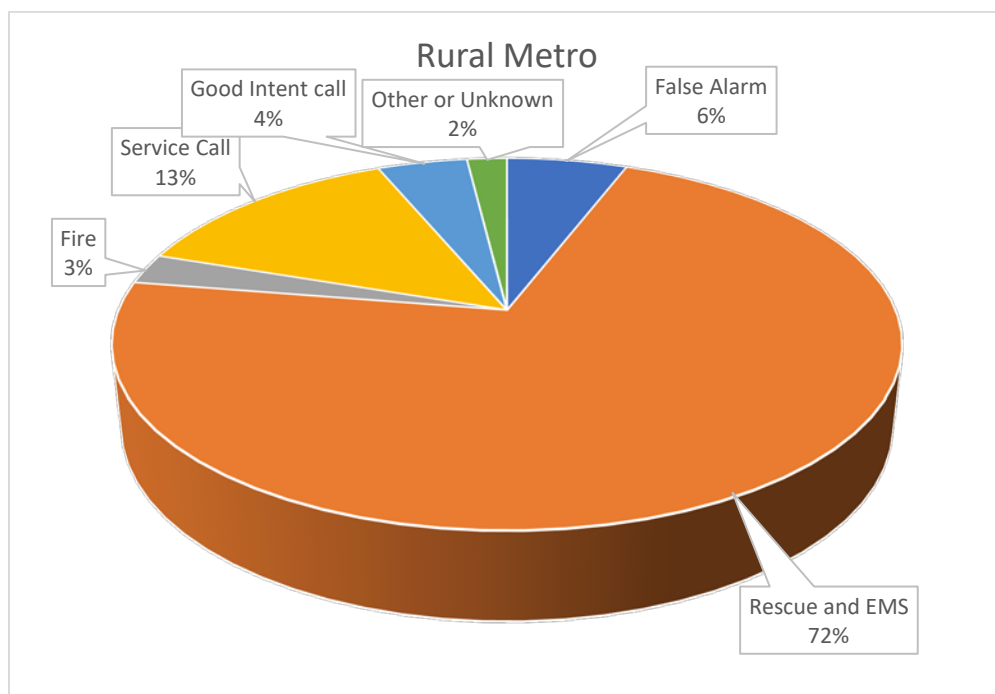
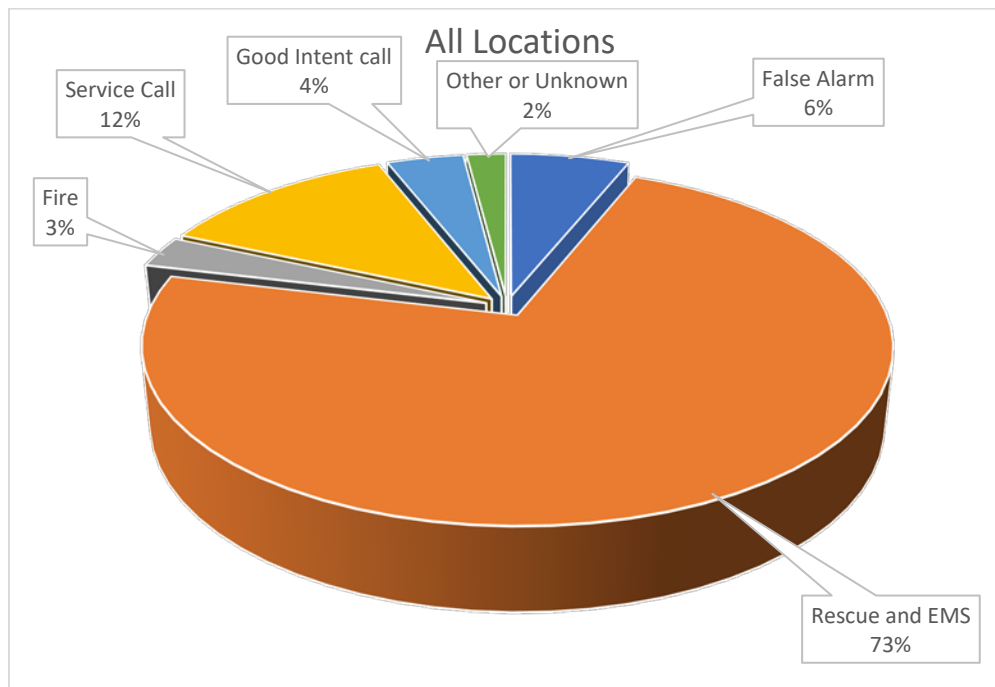
The remaining 17,797 non-cancelled/test incidents were grouped by these general NFIRS categories:

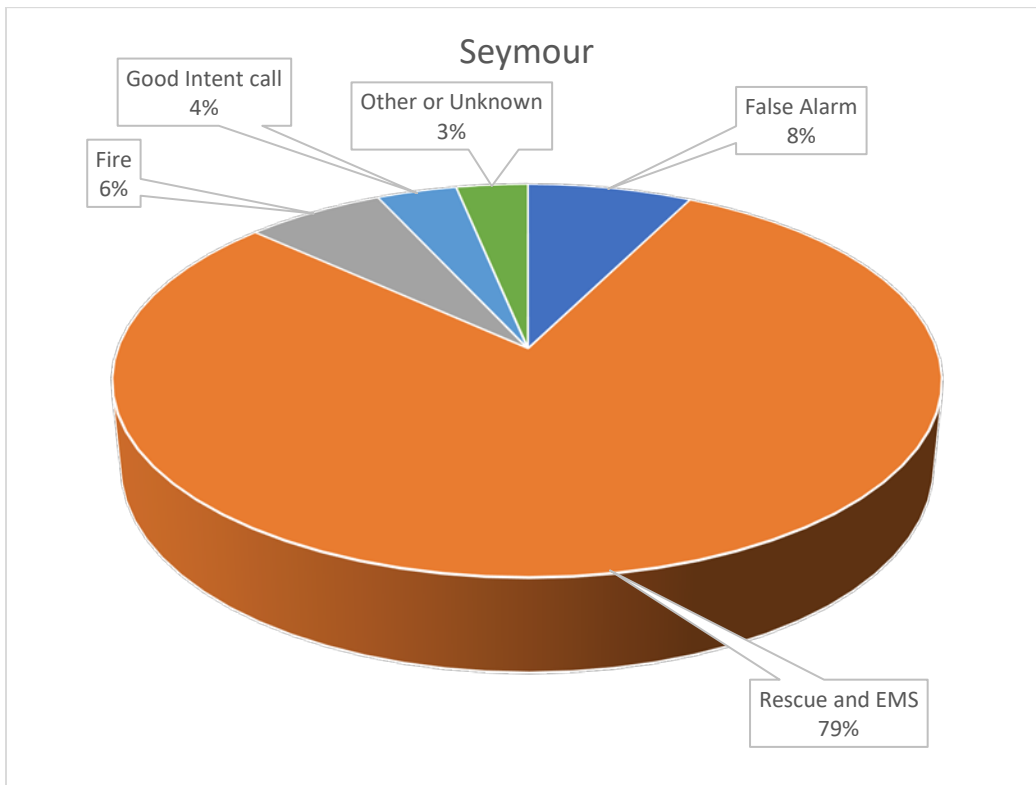
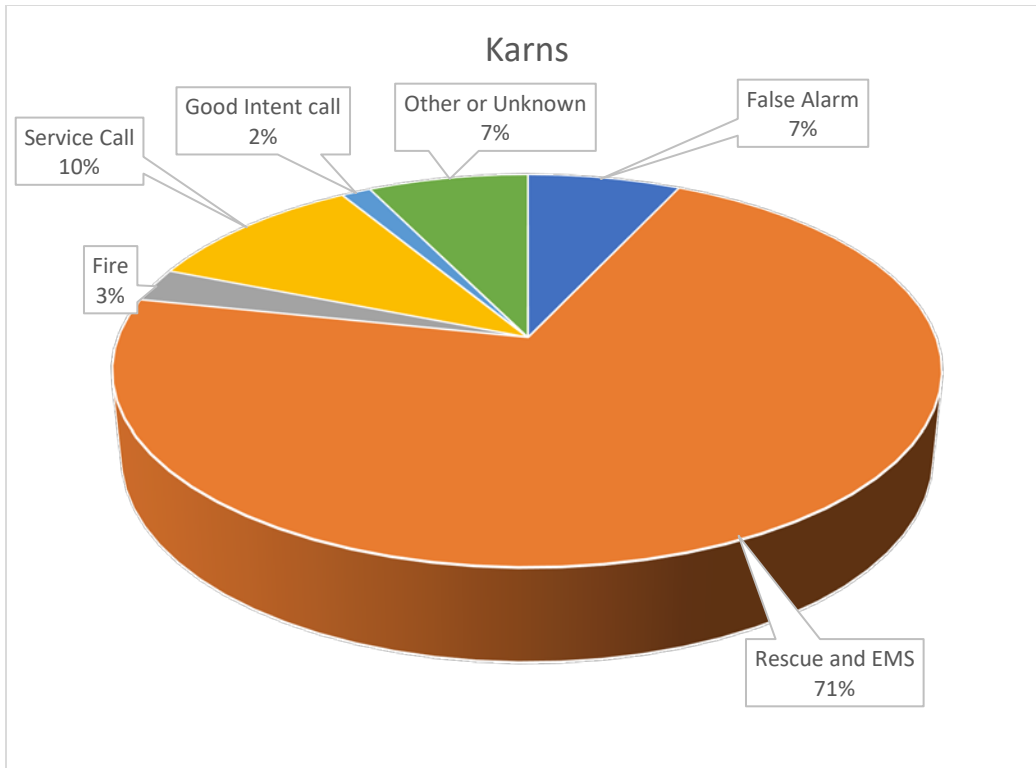
False Alarm or False Call	1,094
Fire	514
Good intent call	705
Hazardous Condition	192
Overpressure rupture, explosion, overhear	12
Rescue and EMS	12,919
Service Call	2,205
Severe Weather or Natural Disaster	72
Special incident	11
Unknown	73
Total Non-cancelled Incidents	17,797

The number of total incidents by source are separated by type and agency in the table below:

	False Alarm or False Call	Fire	Good intent call	Hazardous Condition	Overpressure rupture, explosion, overhear	Rescue and EMS	Service Call	Severe Weather or Natural Disaster	Special Incident	Unknown	Cancelled/ Test	Total
Karns	165	65	32	30	1	1,684	243	11	0	1	249	2,481
KVERS	0	1	21	0	0	346	40	0	0	30	1,225	1,663
RMFD	851	382	614	160	11	10,062	1,922	51	11	20	2,101	16,185
SVFD	78	66	38	2	0	827	0	10	0	22	4	1,047
Total	1,094	514	705	192	12	12,919	2,205	72	11	73	3,579	21,376

The following charts show incident category percentages for all incidents, as well as for Karns, RMFD, and Seymour.





Incident Response Time

The incident response time was calculated as the difference of the alarm time and the arrival time recorded for each incident. Of the 21,376 logged incidents, 4,099 did not include an alarm or arrival time. Of these 4,099, 74%, or 3,309, were “Dispatched and cancelled in route,” or labeled as test records. In addition to the 4,099 records that did not have a response time, were 174 records that recorded either an alarm or arrival time that was less than 30 seconds, including negative values, of which 153 were not labeled as cancelled or test records. These were excluded, so records that have response times greater than or equal to 30 seconds and that were not recorded as cancelled/test records were used to estimate response times across districts. In a few cases, the dispatching location may not be the same as the district location of the incident, such as for mutual aid dispatches.

Excluding cancelled/test records and those outside the time constraint criteria described above, 16,798 incidents could be geocoded within specific fire districts. Median, mean, and 90th percentile response times for these incidents were assessed for each district. Only 10 of the 1,015 incidents recorded within the Seymour district had response times, so these were excluded from the calculations.

	90th percentile	Median	Mean
Karns 1	12.5	9.0	9.0
Karns 2	12.8	8.9	8.9
RM10	13.6	9.5	9.5
RM15	10.1	7.1	7.1
RM16	12.1	8.3	8.3
RM17	12.9	8.7	8.7
RM25	12.4	8.5	8.5
RM26	13.8	8.7	8.7
RM27	11.6	8.4	8.4
RM28	11.3	7.9	7.9
RM30	12.3	7.8	7.8
RM31	11.0	7.3	7.3
RM32	11.6	7.7	7.7
RM33	10.8	6.6	6.6
RM34	11.6	8.6	8.6
RM36	12.7	8.9	8.9
RM41	10.0	6.5	6.5
RM42	10.0	7.1	7.1
RM44	9.4	6.2	6.2

Staffing

The following information was requested from each of the agencies. The rescue squad did not submit.

Department	Station #	Approximate Building Age	Lease/Own	Apparatus #1	On-duty Staffing	Apparatus #2	Staffing Apparatus #3	Staffing Apparatus #4	Live-in Personnel?	If yes, how many?	Other Information
Rural Metro Fire	10	17	Lease	Engine 210	2	Tower 210	2	BC-21	1	Yes	2
Rural Metro Fire	15	34	Own	Engine 215	2	WT 215	on call		0	No	
Rural Metro Fire	16	24	Lease	Engine 216	2					No	Proposed relocation to Westland Drive
Rural Metro Fire	17	21	Lease	Engine 217	2					No	
Rural Metro Fire	25	25	Lease	Engine 225	2					No	
Rural Metro Fire	26	17	Lease	Engine 226	2	WT 226	on call			Yes	0
Rural Metro Fire	27	25	Lease	Engine 227	2	Squad 227	live-in			Yes	0
Rural Metro Fire	28	20	Lease	Engine 228	2	WT 228	on call			Yes	1
Rural Metro Fire	30	23	Own	Engine 230	2	BC-22	1			No	
Rural Metro Fire	31	8	Lease	Engine 231	2	Squad 231	live-in			Yes	1
Rural Metro Fire	32	18	Lease	Engine 232	1 (8-5)	WT 232	on call			Yes	1
Rural Metro Fire	33	17	Lease	Engine 233	2					No	Building owned by community organization
Rural Metro Fire	34	11	Lease	Engine 234	2	Medic 234	2	WT 234		No	Building owned by community organization
Rural Metro Fire	36	0	Lease	Engine 236	2	Truck 236	2	Rescue 121	1	No	
Rural Metro Fire	41	29	Own	Engine 241	3	Medic 241	2	HM 241	live-in	Yes	0
Rural Metro Fire	42	3	Lease	Engine 242	2					No	Owened by Knox County (PILOT)
Rural Metro Fire	44	15	Lease	Engine 244	2	Rescue 124	1			No	
Rural Metro Fire	67	1	Lease	Engine 267	0					No	On call staffing only
KIVERS	East	60	Own	Rescue 123	1						Info supplied by RMFD
Karns F.D.	1	37	Own	Engine 1	2	Tanker 1	0	Reserve 1	0	No	
Karns F.D.	2	4	Own	Engine 2	2	Tower 1	1	Reserve 2	0	No	Weekday Assistant Chief Staffed
Karns F.D.	3	25	Own	Engine 3	Vol.	Tanker 3	Vol.			No	
Karns F.D.	4	27	Own	Reserve 3	Vol.					No	
Seymour VFD	2	30	Own	E504	1 (8-5)	Support 521	Vol.			No	Administration available 8-5/weekdays
Seymour VFD	6	4	Lease	E505	Vol.	Support 502	Vol.	Truck 503	0	Yes	2

Apparatus

The fire departments submitted information as outlined below for each of their apparatus.

County Apparatus Inventory										
Department	Station	Year	Manufacturer	Apparatus Kind	Apparatus Type	Tank Size	Pump Capacity	Frontline/ Reserve	Other Info.	
Rural Metro Fire	10	1998	Pierce	Engine	1	750	1500	Frontline		
Rural Metro Fire	10	2001	E-one	Tower	1	500	2,000	Frontline	100' platform	
Rural Metro Fire	15	2005	Pierce	Engine	1	750	1500	Frontline		
Rural Metro Fire	15	1996	Smeal	Water Tender	2	1000	1250	Frontline		
Rural Metro Fire	16	2006	Rosenbauer	Engine	1	1000	1500	Frontline		
Rural Metro Fire	17	1995	Luverne	Engine	1	750	1250	Frontline		
Rural Metro Fire	25	2003	Ferrara	Engine	1	750	1500	Frontline		
Rural Metro Fire	26	2013	Ferrara	Engine	1	750	1500	Frontline		
Rural Metro Fire	26	2005	Ferrara	Water Tender	1	1250	2500	Frontline		
Rural Metro Fire	27	1994	Pierce	Engine	1	750	1500	Frontline		
Rural Metro Fire	28	1998	Smeal	Engine	1	750	1250	Frontline		
Rural Metro Fire	28	2001	Smeal	Water Tender	2	1500	1250	Frontline		
Rural Metro Fire	30	2002	Pierce	Engine	1	750	1500	Frontline		
Rural Metro Fire	31	2012	Ferrara	Engine	1	750	1500	Frontline		
Rural Metro Fire	31	2001	International	Utility				Frontline	light & air unit	
Rural Metro Fire	32	1994	Ferrara	Engine	1	1000	1250	Frontline		
Rural Metro Fire	32	2005	Ferrara	Water Tender	2	1500	1250	Frontline		
Rural Metro Fire	33	1999	Pierce	Engine	1	1000	1250	Frontline		
Rural Metro Fire	34	2008	Pierce	Engine	1	750	1500	Frontline		
Rural Metro Fire	34	2001	Smeal	Water Tender	2	1500	1250	Frontline		
Rural Metro Fire	34	2014	Braun	Ambulance	3				ALS ambulance	
Rural Metro Fire	36	2013	Pierce	Engine	1	750	1500	Frontline		
Rural Metro Fire	36	1996	Smeal	Truck	1	500	1500	Frontline	75' aerial	
Rural Metro Fire	41	2008	Pierce	Engine	1	750	1500	Frontline		
Rural Metro Fire	41	1987	Saulsbury	Rescue	1	0	0	Frontline	Heavy rescue unit assigned as hazmat unit.	
Rural Metro Fire	41	2014	Braun	Ambulance	3			Frontline	ALS ambulance	
Rural Metro Fire	42	1993	E-one	Engine	1	750	1250	Frontline		
Rural Metro Fire	44	2003	HME	Engine	1	750	1250	Frontline		
Rural Metro Fire	Fleet	1994	Pierce	Engine	1	750	1500	Reserve		
Rural Metro Fire	Fleet	1992	Luverne	Engine	1	1000	1250	Reserve	Scheduled for replacement	
Rural Metro Fire	Fleet	1990	Pierce	Engine	1	750	1250	Reserve	Scheduled for replacement	
KARNS F.D.	1	2017	Sutphen	Engine	1	750	1,500	Frontline	Injected foam, Vehicle Ex. Equipment	
KARNS F.D.	1	2012	Pierce	Engine	1	570	1,500	Frontline	CAFS Foam, Vehicle Ex. Equipment	
KARNS F.D.	1	1998	Freightliner	Water Tender	2	2,000	250	Frontline		
KARNS F.D.	2	2015	Sutphen	Engine	1	750	1,500	Frontline	Injected foam, Vehicle Ex. Equipment	
KARNS F.D.	2	2003	E-one	Engine	1	750	1,500	Reserve	Vehicle Ex. Equipment	
KARNS F.D.	2	1989	GMC	Water Tender		1800	0	Reserve		
KARNS F.D.	2	2017	Sutphen	Tower	1	500	2000	Frontline	70 ft aerial platform, rope rescue , Vehicle Ex. Equipment	
KARNS F.D.	3	2001	E-one	Engine	1	750	1,250	Frontline		
KARNS F.D.	3	2003	Freightliner	Water Tender		2000	0	Frontline		
KARNS F.D.	4	1987	E-One	Engine	1	500	1,000	Reserve		
SVFD	6	1988	Federal	Engine	1	300	1500	Frontline	Truck 503, Elavated master stream	
SVFD	6	1992	GMC	Engine		1000	1000	Frontline	Engine 511, 2 person cab	
SVFD	2	1996	Freightliner	Engine		1000	1250	Frontline	Engine 504, 2 person cab	
SVFD	2	2013	Ford - F250	Support				Frontline	Support 516	

Average Age of Apparatus

Agency	Engine-Frontline	Engine-Reserve	Ladder Company	Water Tender
RMFD	16.5	27	18	17
KFD	7.75	18.5	1.5	19
SVFD*	27			

*Additional equipment located in Blount and Sevier Counties

The rescue squad did not submit their information in the same manner as requested above. The table below indicates the information submitted:

Truck #	Year	Make	Model	Mileage	Location
New 121	2017	FREIGHTLINER	M2	3936	North
R-121	2008	FORD	F - 550	94829	North
R-122	2006	FORD	F - 550	175964	East
R-123	2014	FORD	F - 550	80715.5	East
R-124	2017	FREIGHTLINER	M2	10541	West
New RR	2018	FORD	F - 550	New	East
R-125	2002	FREIGHTLINER	F - L50	24251.6	East
R-127	1995	FORD	F - 350	144507.9	East
R-128	2016	FORD	F - 350	12313	East
R-133	1984	FORD	F - 700	164294.2	East
R-134	1999	FORD	F - 450	185041	West
R-135	2005	FORD	F - 350	14908	East
R-136	2008	FORD	F - 550	19978.2	East
R-111	2014	FORD	EXPLORER	47680	West
R-112	2014	FORD	EXPLORER	83978	East
R-113	2014	FORD	EXPLORER	48725	North
R-114	2014	FORD	EXPLORER	25388	East

There are additional technical rescue trailers, boats, all-terrain vehicles, etc. that were not submitted.

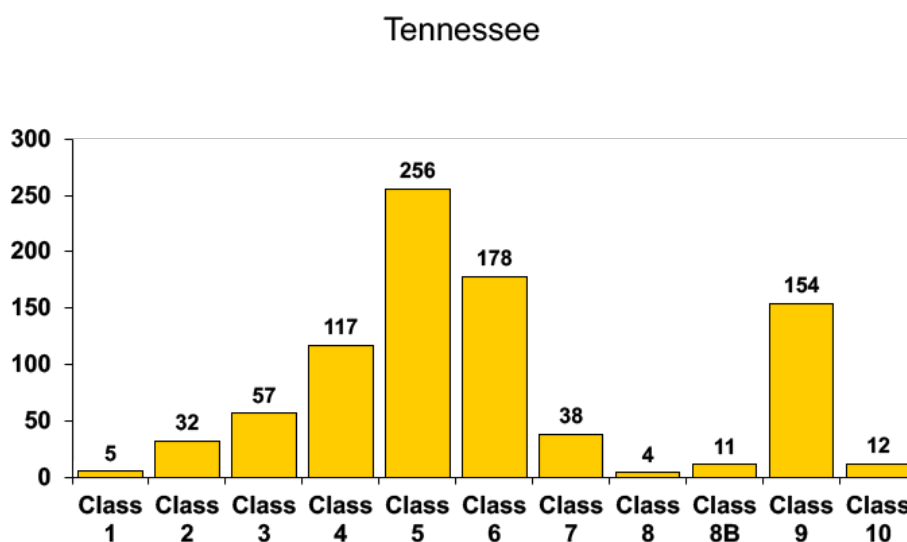
ISO Ratings

The Insurance Services Office, Inc. (ISO) conducts evaluations throughout the country to determine the Public Protection Classification (PPC) ratings for communities.

According to ISO, a community's PPC depends on:

- emergency communications systems, including facilities for the public to report fires, staffing, training, certification of telecommunicators, and facilities for dispatching fire departments
- the fire department, including equipment, staffing, training, and geographic deployment of fire companies
- the water supply system, including the inspection and flow testing of hydrants and an evaluation of the amount of available water compared with the amount needed to suppress fires
- community efforts to reduce the risk of fire, including fire prevention codes and enforcement, public fire safety education, and fire investigation programs

In each of those protection areas, ISO analyzes the relevant data and assigns a Public Protection Classification — a grading from 1 to 10. Class 1 generally represents superior property fire protection, and Class 10 indicates that the area's fire suppression program does not meet ISO's minimum criteria. The chart below indicates the current PPC ratings in Tennessee.



Most U.S. insurers of home and business properties use ISO's PPC data in calculating premiums. In general, the price of insurance in a community with a good PPC is lower than in a community with a poor PPC.

The PPC ratings can be classified as:

- Straight rating- All structures within five driving miles of a fire station will receive the PPC rating (example: Class 5)
- Split rating- All structures within five driving miles of a fire station and 1,000 feet of a fire hydrant will receive the class rating on the left of the "/" (example: Class 5/5X). All structures within five

driving miles of a fire station but are beyond 1,000 feet of a fire hydrant will receive the class rating to the right of the “/” (example: 5/5X) Previously the “_X” denoted was classified a “9”.

- Any structure located beyond 5 driving miles of a fire station, regardless of the PPC rating, will receive a Class 10 rating. A class rating greatly increases the availability and cost of insurance.

The following table indicates the current ratings in Knox County outside the city of Knoxville:

Agency	Ratings	Year Evaluated
RMFD	3/3X	2016
Karns	4	2016
Seymour	5/5X	2016

Training Facilities

Training facilities are very limited in the county. Seymour and Karns do not have a dedicated training facility. Rural/Metro has a portable training tower (Figure 18), burn building constructed from shipping containers (Figure 19), and various props (Figure 20) at the Ambulance Operations Center in the Westbridge Industrial Park.

At the time of this report, a new location for this was being negotiated near the Pellissippi State Community College campus in the Karns community. That location would be the fifth site in the past 25 years for the department. While it is very creative in the efforts to conduct training, the facilities are inadequate for the agencies serving Knox County. The Knoxville Fire Department does have a training facility located off Prosser Road in East Knoxville. The training facility needs of the Knoxville Fire Department have exceeded the capacity of the current location.



Figure 18 RMFD Portable Training Tower



Figure 19 RMFD Burn Building and Ventilation Prop



Figure 20 RMFD Fire Props

Fire Hydrants/ Water Supply

Knox County, through progressive planning regulations and cooperation of most of the private utility districts, does have an extensive network of fire hydrants. Figure 21 shows the location of the hydrants throughout the county except for the Northeast Knox Utility District data (not supplied to KGIS).

As mentioned earlier, ISO classifies structures located within 1,000 feet of a fire hydrant with a better Public Protection Classification for communities that have a split rating. This is because fire apparatus can place a supply line of 1,000' quickly into service in order to establish a secure water supply from a fire hydrant. In areas beyond 1,000' of a hydrant, pumping relay operations are necessary or a water shuttle supply is utilized with water tender apparatus. This creates the need for additional apparatus and staff in order to establish a water supply for suppression activities.

There are areas that have water lines, but do not fire hydrants placed. This may be because the water line size does not meet the minimum state regulations for fire suppression activities. It is important to maintain the water supply requirements as the county continues to grow. As water lines are added or replaced, the size of the mains should meet or exceed the minimum standards and hydrants placed as appropriate for new construction and existing buildings. The need for water tenders will remain for all the agencies throughout the county.

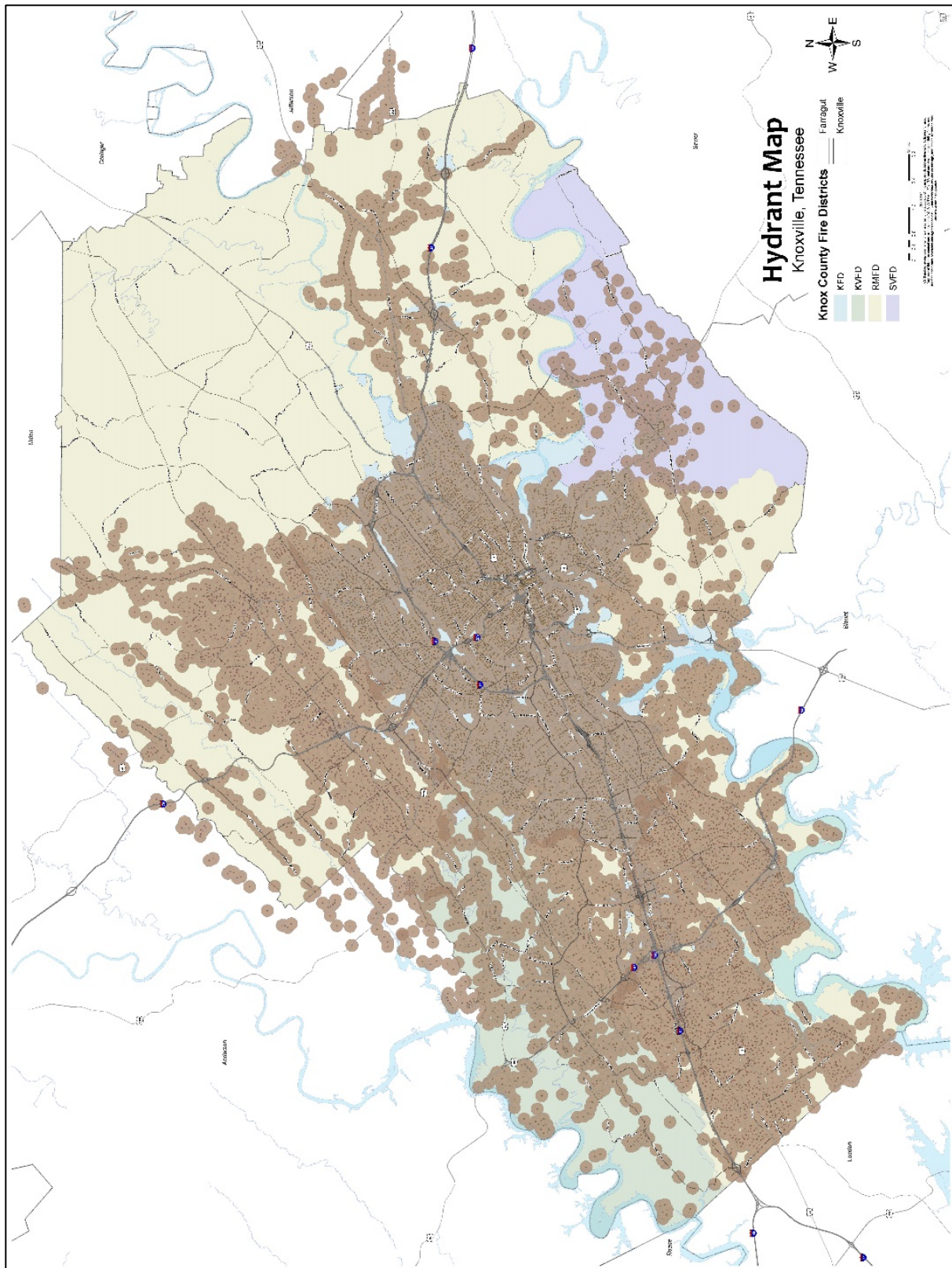


Figure 21 Fire Hydrant 1,000' Zones

Fire Prevention

The Knox County Fire Prevention Bureau (KCFPB) was established by the Knox County Commission in 1984 to enforce applicable codes adopted by the county to reduce the incidence and severity of fires. As noted earlier this was in response to some serious fires and a fatality that had occurred in the west part of the county.

The prevention activities are accomplished through inspections of new and existing commercial and multi-family dwellings, public education programs, and investigation of fires through cooperative efforts of the Knox County Sheriff's Office and the fire departments.

The creation of the KCFPB, working with the Knox County Building Codes Department, was a very progressive initiative taken on by the county to reduce the loss of life and property damage by ensuring that new construction is built to the current adopted codes and working to ensure that existing commercial occupancies are maintained in a safe manner. No other county in Tennessee dedicates the level of resources that Knox County does in their unincorporated areas.

Operations

Services Provided

The table below shows the capabilities of the departments related to first response medical, extrication, and hazardous materials response. Total staffing numbers are summarized as well.

Agency	On-Duty Battalion Chiefs	Staffed ALS Stations	Staffed BLS Stations	Vehicle Extrication Stations	Hazardous Materials Response	Total Full-Time Personnel	Total Part-Time/ Reserve Personnel
RMFD	2- 24 hrs./ day	14	3	6	TEMA Accredited Type II Team	156 (9 on rescue trucks)	65
KFD	1- 8 hrs./ day M-F	2	2 (on call)	3	Operations Level	19	25
SVFD	1- 8 hrs./ day M-F	0	2 (on call)	1	Awareness Level	1	72 (all stations)

Rural Metro Fire Department

Services Provided:

- Fire response
- Two fire division ambulances that back up EMS division
- Advanced and Basic Life Support medical first response
- Vehicle extrication
- TEMA accredited hazardous materials response team
- Public fire education programs
- Fire prevention/ codes enforcement for Town of Farragut
- Public education employee with Knox County Fire Prevention Bureau

Karns Fire Department

Services Provided:

- Fire response
- Advanced and Basic Life Support medical first response
- Pays for dispatching by Knox County 911
- Operations level hazardous materials response
- Rope rescue/vehicle extrication capabilities
- Public education program

Seymour Vol. Fire Department

Services Provided:

- Fire response
- Basic Life Support medical first response (on-call)
- Vehicle extrication
- SAFER grant (temporary funding) to provide stipend to staff station on nights and weekends by volunteers
- Public education program/ Smoke alarm program

Knoxville Vol. Rescue Squad

Services Provided:

- Vehicle/ heavy extrication
- Advanced and Basic Life Support medical first response (on call)
- Technical rescue teams: Swiftwater, Cave, Collapse, Trench, Vertical/ Low Angle Rope, Dive, Confined Space, Machinery/ Farm
- Deputy Chief paid (part-time)
- Business manager and community outreach
- Approximately 60 volunteers
- Nine full-time personnel (referenced in “Staffing Section”) are employed by RMFD in a cooperative agreement with KVERS. Uniforms, gear, etc. paid for by the rescue squad.

NFPA Standards

The National Fire Protection Association (NFPA) is a not-for-profit corporation that develops “voluntary consensus standards” to promote the science and improve the methods of fire protection and safety related goals. These stages of the development process for the standards and codes include:

- Public input
- Public comment
- NFPA Technical Committee meetings
- Council appeals and issuance of standard

Each technical committee is comprised of a diverse group of stakeholders from the public and private sector. Within the four distinct stages there are multiple steps for the final standard to be a truly consensus-based document.

NFPA 1710: Standard for the Organization and Deployment of Fire Suppression Operation, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments and NFPA 1720: Standard for the Organization and Deployment of Fire Suppression Operation, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments contain the minimum requirements relating to the organization and deployment of career and volunteer fire departments. NFPA 1710 and 1720 are not required by law but are considered the standard used to organize and deploy resources by fire departments.

NFPA 1720 1.1 states that the standard is applicable to volunteer and combination fire departments. While all three of the fire departments meet the definition of a combination department, RMFD is more applicable to the career staffed fire department with nearly 75% of the staff working full-time. The majority of the active members of KFD are career staff.

Due to the size of the unincorporated area of Knox County, the types of commercial development, and the density of residential development; the NFPA 1710 standard is referenced for analysis and planning purposes.

The NFPA 1710 response standard addresses staffing by structure type and size:

Structure Type	Size	Minimum Staffing/Min. with Aerial Device Deployed
Single Family Dwelling	2,000 ft ²	14/ 15
Open Air Strip Mall	13,000 ft ² to 196,000 ft ²	27/ 28
Garden Style Apartment	1,200 ft ² apartment, 3 stories	27/ 28
High- Rise	> 75 ft from fire dept. access	42/ 43

The normal daily staffing levels as indicated on the table in the “Staffing” section shows that all of the fire departments rely on multiple dispatched companies and call back of off-duty career, reserve, and volunteer personnel in order to meet the minimum standards. It is important to note that the minimum standards may be insufficient based upon incident complexity and environmental conditions at the time of response.

Response time benchmarks established in NFPA 1710 4.1.2.1:

- Turnout time-
 - Fire and special operations response: 80 seconds
 - EMS response: 60 seconds
- Fire suppression incident response time-
 - Initial arriving engine company: 4 minutes
 - Initial full alarm assignment: 8 minutes
- Emergency medical incident response time-
 - Basic life support (automated external defibrillator): 4 minutes
 - Advanced life support unit: 8 minutes

NFPA 1720 response standard is categorized by community demographics:

Demand Zone	Demographics	Min. Staff to Respond	Response Time (minutes)	Meets Objective (%)
Urban area	> 1,000 people/mi ²	15	9	90
Suburban area	500-1,000 people/ mi ²	10	10	80
Rural area	< 500 people/mi ²	6	14	80
Remote area	Travel distance ≥ 8 miles	4	Dependent on travel distance	90

NIST Study

Crew size and staffing are important factors in providing a reliable and efficient delivery of emergency services. Fire departments today provide a larger variety of services compared to 30 years ago. In addition to fire suppression; fire prevention, public education, vehicle extrication, technical rescue, EMS response, hazardous materials, natural and manmade disasters require a wide variety of training and equipment, as well as, the personnel needed to respond.

The National Institute of Standards and Technology (NIST) conducted more than 60 fireground field experiments and released a report titled *NIST Report on Residential Field Experiments* in 2010 to determine the effect of crew size on basic residential fireground activities. Some of the highlights from that report include:

- The four-person crews completed all tasks on the fireground on average seven minutes faster (30%) than the two-person crews.
- The four-person crews put “water on the fire” 16% faster than two-person crews. Three-person crews were 10% faster than the two-person crews.
- The four-person crews completed laddering and ventilation activities 30% faster than the two-person crews and 25% faster than the three-person crews.
- The four-person crews started and completed primary search and rescue functions 30% faster than the two-person crews.

There is a direct correlation between crew size and the time required to complete critical fireground tasks that impact firefighter and occupant safety.

Funding

Current Model

As part of the study, the location and distribution of Knox County fire service subscribers was evaluated. RMFD and KFD each provided lists of paid subscribers. Seymour provided a list of donations from their Knox County service area. A total of 47,075 parcel records for the Knox fire district services were identified. (For the purpose of the analysis, the Seymour donations are referred to as “subscribers”) The record format differed among these providers. RMFD records include a parcel id, lists for KFD had address only, and Seymour data had name and address. Seymour data also included subscribers outside Knox County, so those which had a zip code of 37920 and those in 37921 in the vicinity of Johnson College were selected from these data. Most records in the RMFD list could be matched to parcel ids. Remaining records in RMFD and all of KFD and Seymour were matched to Parcel IDs by name and address (where available) or address only using Parcel address fields. Parcel matching rates for RMFD was 99.6 %, while matched rates for KFD and Seymour were 93.3% and 94.1% respectively.

Area	Total	Unique	Parcel ID Match	Address Match	Total No. Match	Total % Match
RMFD	39,386	39,386	38,533	681	39,214	99.60%
KFD	6,947	6,725	0	6,275	6,275	93.30%
Seymour	742	742	0	698	698	94.10%
Total	47,075	46,853	38,533	7,654	46,187	98.60%

To estimate building density for fire service subscribers, building footprints located inside subscribed parcels were selected. Using this parcel matching method, 64,052 buildings, or 40.9% of all Knox Fire District buildings are within parcels identified as belonging to subscribers. The areal extent of subscriber parcels is 25.9 percent of the total parcels located within Knox County fire districts.

The table following shows the assigned tax class of buildings within the study area, with estimated numbers and percentages of buildings that are subscribed . Subscribed building location and density are shown on the two figures following the table. Figure 22 is a map of this density using the same method as for all Knox County fire service area buildings is shown in the figure below, using the same kernel density classification method and interval. Figure 23 shows the rate of subscription buildings per 100 total buildings located within each Knox County fire district. Figure 24 is a map by fire district showing the percentage of subscribed commercial and industrial buildings located within each district.

Buildings by Tax Class by District

(C=Commercial, I=Industrial, R=Residential, A=Agriculture, O=Other, Exempt, Not Loaded)

District	Total Buildings by Tax Class					Subscribed Building by Tax Class					Percent Subscribed				
	C	I	R	A	O	C	I	R	A	O	C	I	R	A	O
Karns 1	1002	1	10803	352	338	607	0	5348	180	259	60.6%	0.0%	49.5%	51.1%	76.6%
Karns 2	274	3	6057	500	181	145	3	3167	270	87	52.9%	100.0%	52.3%	54.0%	48.1%
RM10	745	59	4662	41	238	353	18	2615	12	195	47.4%	30.5%	56.1%	29.3%	81.9%
RM41	852	1	9329	116	306	342	0	4974	90	226	40.1%	0.0%	53.3%	77.6%	73.9%
RM44	81	0	2987	76	39	33	0	1604	50	34	40.7%	NA	53.7%	65.8%	87.2%
RM15	1094	5	8248	10	136	351	0	3863	0	92	32.1%	0.0%	46.8%	0.0%	67.6%
RM16	132	0	5223	45	125	81	0	2514	26	54	61.4%	NA	48.1%	57.8%	43.2%
RM17	135	0	7850	178	85	62	0	4338	102	48	45.9%	NA	55.3%	57.3%	56.5%
RM25	433	26	9998	944	174	242	9	3045	320	102	55.9%	34.6%	30.5%	33.9%	58.6%
RM26	295	1	7945	753	199	86	1	2488	346	91	29.2%	100.0%	31.3%	45.9%	45.7%
RM27	316	85	3621	342	81	153	15	1157	142	40	48.4%	17.6%	32.0%	41.5%	49.4%
RM28	222	12	6873	323	162	46	0	2594	136	67	20.7%	0.0%	37.7%	42.1%	41.4%
RM30	1129	9	13729	603	359	270	0	4843	232	220	23.9%	0.0%	35.3%	38.5%	61.3%
RM31	1148	8	6370	92	215	224	4	2751	65	118	19.5%	50.0%	43.2%	70.7%	54.9%
RM32	219	0	2613	288	51	50	0	616	121	14	22.8%	NA	23.6%	42.0%	27.5%
RM33	24	0	1659	565	30	10	0	527	256	16	41.7%	NA	31.8%	45.3%	53.3%
RM34	283	20	9924	704	276	69	0	3580	293	165	24.4%	0.0%	36.1%	41.6%	59.8%
RM36	249	4	8035	142	117	141	2	3085	70	52	56.6%	50.0%	38.4%	49.3%	44.4%
RM42	28	0	2864	148	81	0	0	1407	47	13	0.0%	NA	49.1%	31.8%	16.0%
SVFD52*	191	17	8056	631	269	16	9	1315	205	23	8.4%	52.9%	16.3%	32.5%	8.6%
Total	8852	251	136846	6853	3462	3281	61	55831	2963	1916					

* SVFD 52 is not subscription based, but is matched with the data from the fundraising donations

In addition to the subscription programs for Rural/Metro and KFD, Seymour relies heavily on donations from the community. The department expends significant time with mail-out campaigns, “boot drives”, etc. in order to increase the number of donations to operate. KFD, Seymour, and the Knoxville Volunteer Emergency Rescue Squad also receive donations from charitable non-profit organizations. The amount of the funds received varies from year to year and is not a reliable source of income for operating purposes.

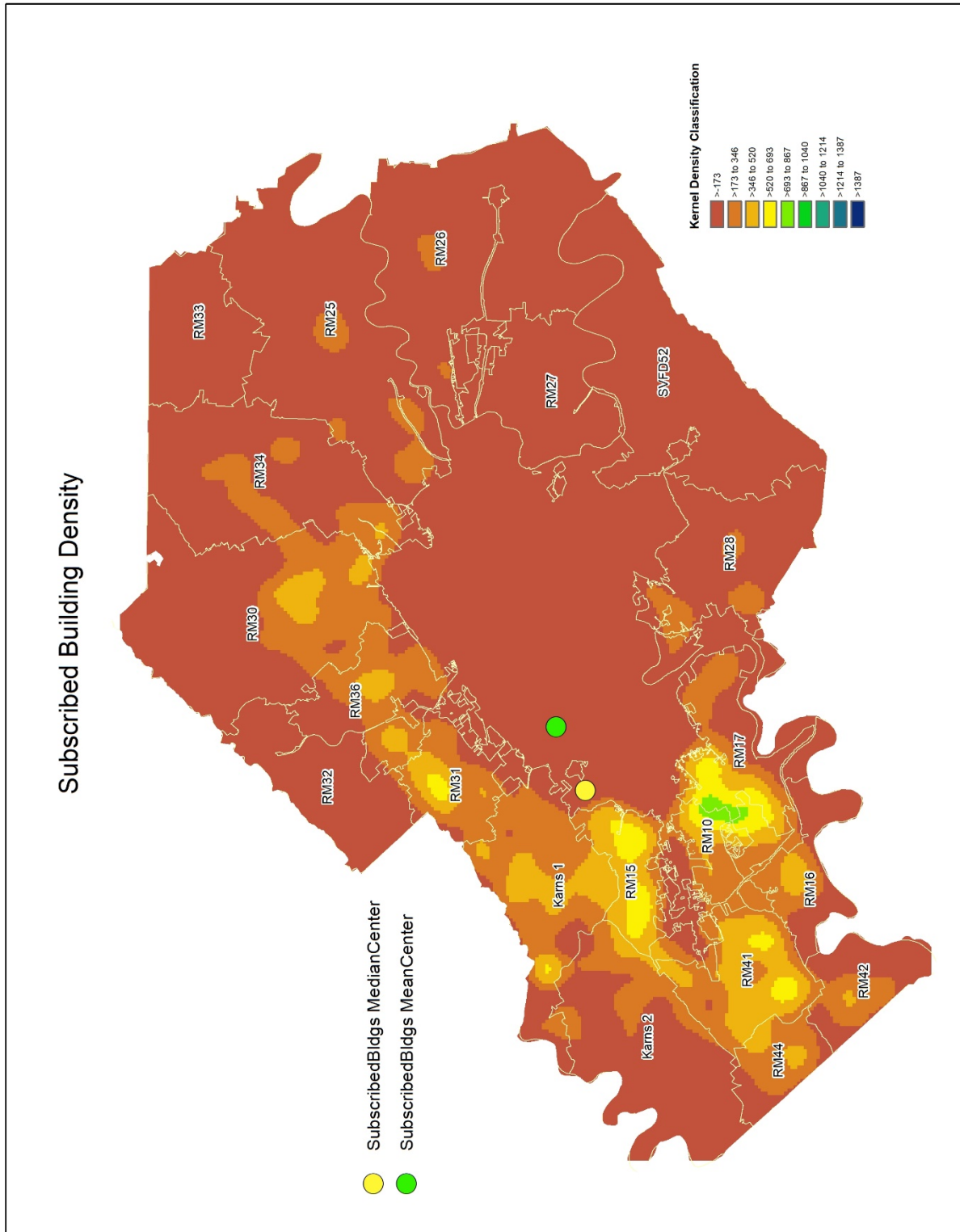


Figure 22 Subscribed Building Density

Subscribed Building Rate by Knox Fire District

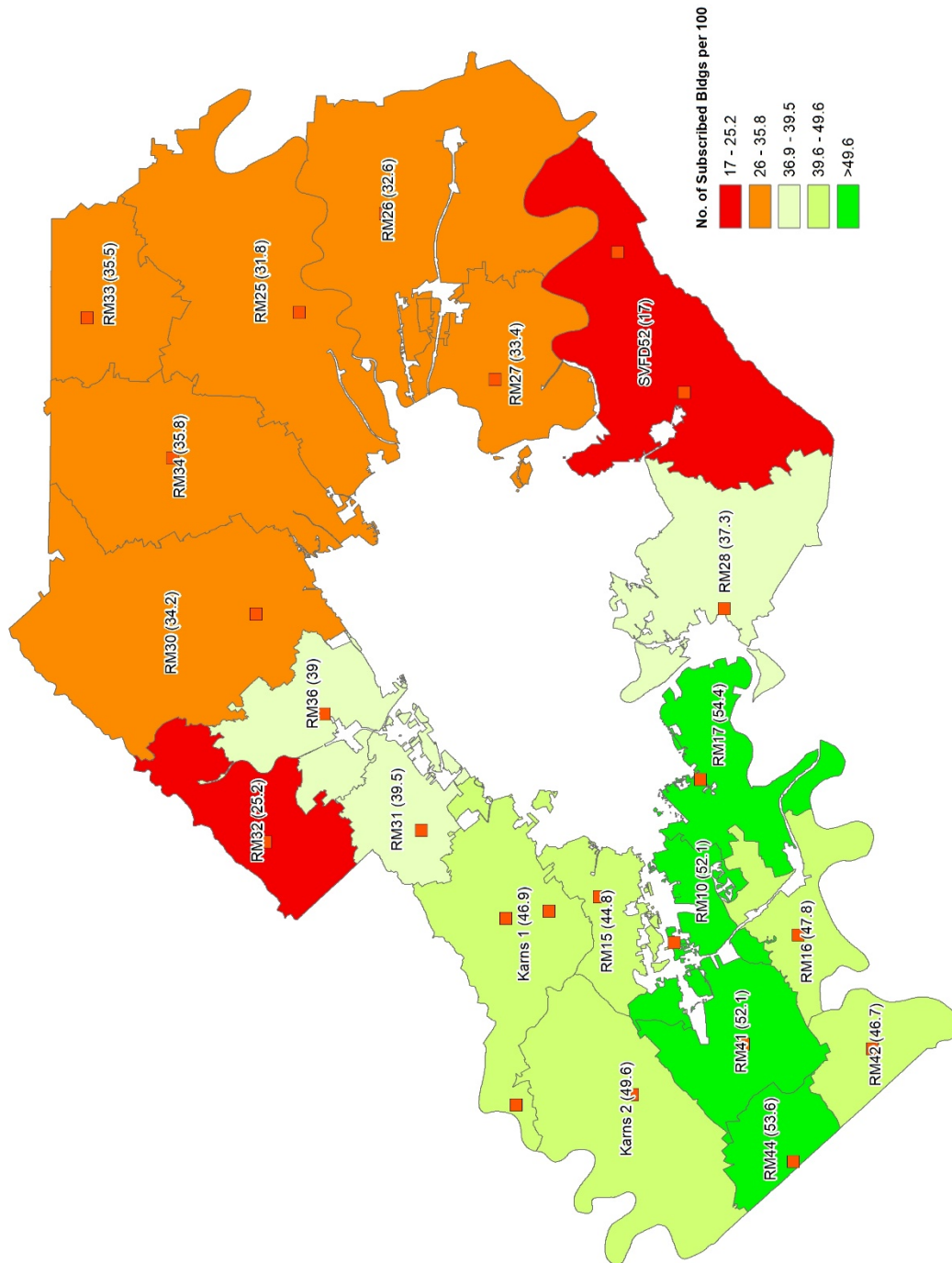


Figure 23 Subscribed Building Rate by Fire District

Percentage of Subscribed Commercial and Industrial Buildings

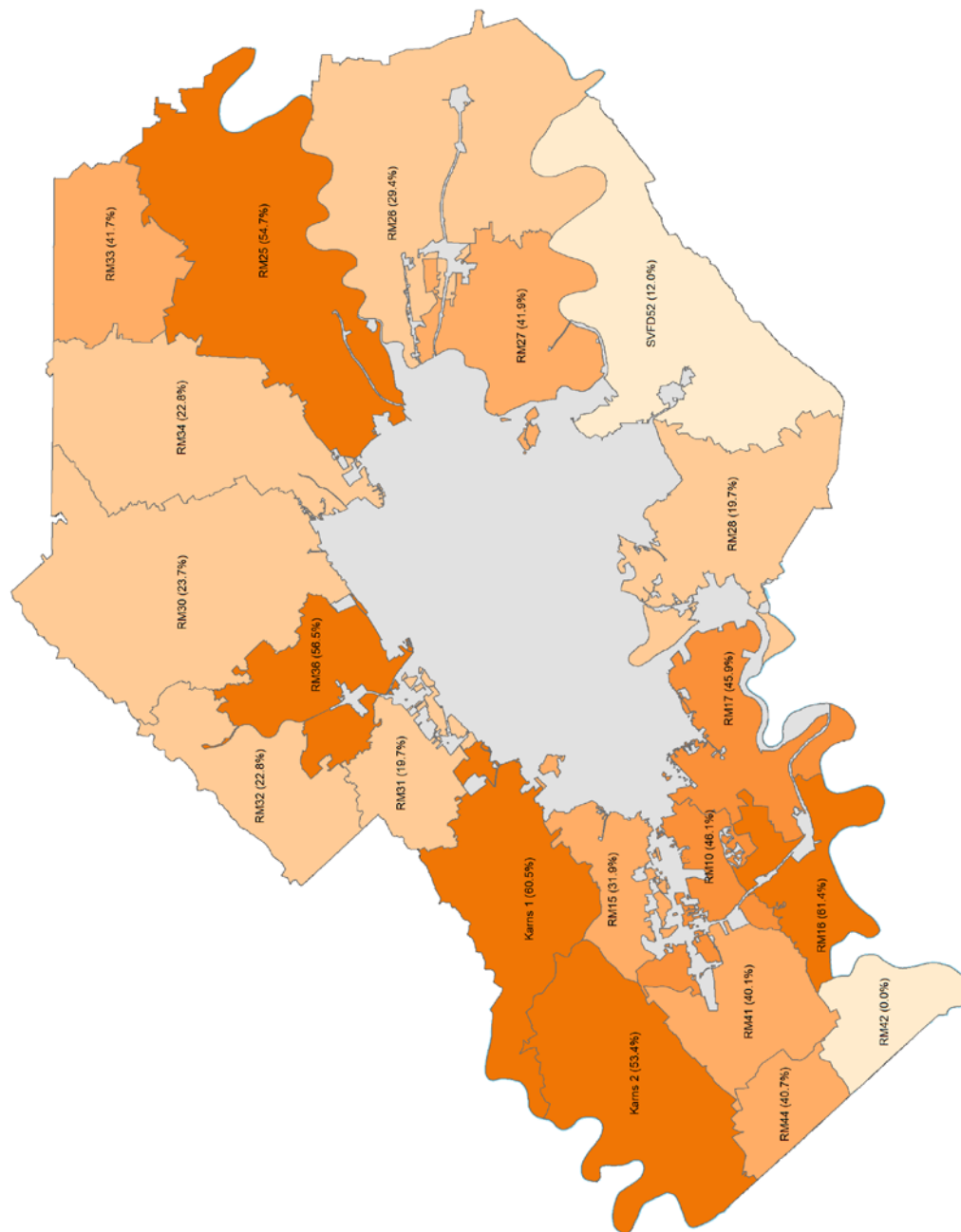


Figure 24 Percentage of Subscribed Commercial and Industrial Buildings by Fire District

Public Funds

The Knox County Commission has in recent years appropriated a higher amount of funds for the not-for-profit fire and rescue agencies. This has been a mix of year end designations and defined services contracts.

Knox County Contributions

	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
KVERS	\$242,500	\$200,000	\$200,000	\$300,180	\$500,000	\$500,000	\$550,000
SVFD	\$11,400	\$10,000	\$8,400	\$50,000	\$75,000	\$114,500	\$175,000
KFD VFD	\$0	\$0	\$0	\$50,000	\$75,000	\$75,000	\$125,000
Rural Metro	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$253,900	\$210,000	\$208,400	\$400,180	\$650,000	\$689,500	\$850,000

Grant Opportunities

Federal grant opportunities are a source of income that varies each year. While the grants should not be relied on to supplant local fire service funding, they can be utilized to acquire critical equipment, training, and staffing that would not have been available by other means. The Federal Emergency Management Agency (FEMA), through the Assistance to Firefighters Grant (AFG) and the Staffing for Adequate Fire and Emergency Response (SAFER), has contributed over \$10.7 billion since 2001. These grants are available to city, county, and volunteer fire departments. RMFD has not been eligible to apply for the grants because of their status as a for-profit corporation. Seymour and Karns have received grants through this program. Additionally, Knox County has received various Homeland Security funds to improve the emergency services in the county and Homeland Security District Two.

Recommendations

The population in Knox County is projected to exceed 600,000 residents in twenty years. This growth will generate significant demands on the emergency services throughout the county. Additional fire stations will need to be constructed and staffing increased to meet the increased call volume, building density changes, and to create a ready reserve of on-duty personnel for surge capacity in the emergency services system.

Fire protection and rescue services are quality of life factors for the citizens, visitors, and business owners in a community. Many people do not consider the need for these services until they or a loved one experience an emergency medical crisis, are involved in a motor vehicle collision, experience a residential fire or are affected by a natural disaster. A reliable fire protection system also contributes to the recruitment of industry and economic growth.

The following are recommendations to address the current and future needs of the county:

Training Facilities/ Program

There is a significant need for adequate training facilities for all the agencies in Knox County. This would include the city of Knoxville, Rural/Metro Fire, Karns, Seymour and the Knox County Rescue Squad. A partnership between the city and county to locate and construct a new multi-use training facility would be a significant step forward to ensure that all fire and rescue personnel have access to adequate classroom and hands-on training facilities and props. Adding such a facility will enhance learning and improve the skills necessary to mitigate emergency incidents. Training officers from each of the agencies could be located at this facility to encourage collaboration, and aid in subject matter expertise. Collocating these individuals will improve instruction capabilities without duplication of infrastructure and staff. Multi-agency drills and exercises would ensure that agencies will work together more smoothly when providing a coordinated response to all the citizens of Knox County.

Fire Stations

Rural/ Metro Fire Department only owns 3 of its 17 stations. The average age of those facilities are 29 years old. Stations 17 and 25 need replacement. Station 32 in Heiskell needs to be moved further east to reduce the gaps in coverage identified in Figure 14.

We recommended that Knox County begin construction of fire stations to develop the infrastructure necessary for providing fire and rescue services. Station 17, 25, and 32 are the first priorities.

Karns Fire Department owns all its facilities. Station two is the newest facility designed to be staffed 24 hours a day. We recommend that station one is to be replaced as they have out-grown the original volunteer station with staffing and larger apparatus placed in service. The station in Solway also needs replacement or significant renovation in order to accommodate full-time staffing. An additional station will be needed in the Hardin Valley area as construction is anticipated to grow further west.

Seymour Station 2 will need to be replaced as well. The facility is a combination of buildings that were not designed for 24-hour staffing.

The Knox Volunteer Emergency Rescue Squad headquarters station is in east Knoxville in a 60-year-old facility. The KVERS has a tremendous amount of equipment and has outgrown the usefulness of this facility. A more centralized facility should be constructed for the technical rescue apparatus and equipment stock. A facility like the Rutherford County EMS Special Operations or the Sumner County Emergency Management Special Operations facilities would be beneficial to Knox County. Vehicle extrication and certain targeted technical rescue equipment should be placed in fire stations throughout the county.

Apparatus

The average age of a RMFD frontline engine is 16.5 years old and a ladder truck is 19 years old. SVFD average engine age located in Knox County is 27 years old. Karns has invested extensively in the past few years and has an average age of 7.75 and 1.5 years for engine and ladder trucks, respectively. A fleet as large as the apparatus in Knox County must have a vehicle replacement plan that replaces approximately two to three apparatus every year with new trucks. Additional staff and specialized vehicles must be replaced as appropriate.

Staffing

Countywide, there are approximately 50 fire and rescue personnel on duty daily. That number is the highest amount in the history of Knox County. That equates to approximately one fire/rescue worker on duty per every 5,500 residents. That is significantly lower than the 7.59 per 5,500 residents in the United States southern region with populations of 250,000 or greater reported by the NFPA Research division.

All the departments rely extensively on the response of part-time reserves and volunteer personnel, along with off duty career staff to respond to fire and other more complex incidents. This deployment model is not always dependable and can create gaps in the reliability of the resources in the county when multiple incidents occur simultaneously.

Staffing should be increased to align closer with the NFPA standards and NIST fireground research highlighted in this document. SVFD stations should have 24 hour staffing, along with KFD's station in the Solway community.

Department Organization

Knox County is currently served by two not-for-profit fire departments, a not-for-profit rescue squad and for-profit corporate fire department. While the agencies and local staff have done a tremendous job of the creative delivery of public safety services, there are issues with the lack of coordination of services and the lack of permanent facilities countywide.

It is recommended that Knox County begin the process of creating the Knox County Fire Rescue (KCFR) department. The structure of the department could take on many forms and evolve as the needs of the community change over time. The first step would be to pass a resolution creating the agency. The following are options for implementation:

- A contractual arrangement with the existing agencies containing certain contract deliverables regarding staffing, response times, construction and use of facilities, apparatus replacement, and services delivered.

- One or more of the existing agencies consolidate into the functional operations of the KCFR and utilize a contractual arrangement for the remaining agencies as noted above. This is a good transitional model that allows for a gradual increase in the local government involvement in the delivery of public safety services.
- Plans can be made for the consolidation/ absorption of all fire and rescue services into the KCFR. The implementation timeline would depend on many variables including the loss of a private service contractor, reduction in the available reserve/ volunteer personnel, and/or increased demands for services.

A consolidated KCFR would improve the working relationship and coordination of the existing agencies.

Rescue/ Special Operations

The Knox County Volunteer Emergency Rescue squad has functioned for many decades as one of the premier technical rescue organizations in the area. KVERS, like most volunteer fire and rescue agencies struggles to maintain personnel. This is due to many factors, but the decline in volunteers is a problem across the state and nationwide. The department has a tremendous cache of equipment in its inventory.

Vehicle extrication is the high frequency rescue incident type that all communities face. The lessor frequency and often higher consequence technical rescue events must be planned for. Knox County contributes a significant amount of funds to the rescue squad yet does not have any functional control over the management of the agency or deployment of resources. The city of Knoxville also has a technical rescue program that has needs for additional equipment as well as additional trained personnel.

We recommend a functional consolidation of rescue services utilizing the existing personnel of the rescue squad, city and county fire agencies, and the emergency management agency. The program should be placed under the Knoxville/ Knox County Emergency Management Agency (KEMA) for organizational control. An interlocal agreement can be drafted to ensure the protections and direction that an all-hazards technical rescue program would address. Trained fire department personnel along with the volunteer members operating under KEMA, would staff the countywide special operations/ technical rescue division. A full-time program director would need to be added to the KEMA staff to manage the system.

Funding

As indicated in the “Funding” section of this document, there is a large number of parcels, houses, and businesses that do contribute financially to the fire and rescue services in Knox County. Many view paying subscriptions or donating to the volunteer agencies as an option that they will address if/when they need the service. In order to have public safety services available, everyone needs to contribute to the system.

Each of the departments expend a tremendous amount of resources to generate the revenue through subscription (and collections from non-subscribers) as well as fundraising effort that they currently utilize to hire and train personnel, purchase equipment, maintenance of apparatus and facilities, etc. The cost of providing fire and rescue services is unfairly assessed on the private citizen and business owners that “choose” to subscribe. RMFD does not receive funding from Knox County, generating all its revenues directly from the private citizen or business owners. Except for the rescue squad, the other volunteer agencies generate most of their revenue directly from the public as well.

A countywide fire tax district should be established to create a dedicated revenue stream to pay for the infrastructure and delivery of fire and rescue services. The current subscribers would pay less in the fire tax assessment and the county would be able to provide a higher level of service through contracts or directly operate the Knox County Fire Rescue agency.

Summary

This report is an overview of the current levels of fire and rescue services in Knox County. The intent is to highlight the history for the delivery of fire and rescue services, as Knox County transformed from a much smaller jurisdiction to its present size. This path has not been conventional compared to most other jurisdictions in the state, and around the country. Knox County's projected growth over the next 20 years will create additional challenges to the current model of funding and service delivery.

In 1980, well over half the residents of Knox County (55.8%) lived inside the corporate limits of the City of Knoxville, under municipally based fire protection. By 1990, that number had slipped to 53.4%, and by 2000, less than half (47.6%) the population of the county lived under a municipally operated system. This trend continued through 2010 and beyond, and today, only 42.6% of the residents of Knox County live under a municipal fire protection system.

We recommend that Knox County begin a much greater level of involvement with the addition of infrastructure, and assuming control of the fire and rescue services. A change is needed from the subscription, user fees, and donation-based funding models currently administered by the fire departments, to a fire tax district where everyone contributes. This will reduce the amount of money that the current subscribers pay and increase the level of protection for everyone.

This report identifies opportunities in which the city and county can work together to share training and technical rescue services; a cooperation that will benefit both jurisdictions immensely.

As with any initiative there will be resistance to change by a host of individuals and groups, including those currently providing the services and others that do not currently pay for the service. It is important to keep the big picture in mind and understand that the county must coordinate improvements in the public safety system. The recommendations in this report cannot be accomplished in a short timeframe. It is imperative for the elected officials to work with the fire and rescue service providers, and the emergency management staff, to develop an implementation plan which best serves the entire county.